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A HANDY BOOK OF
FISHERY MANAGEMENT
BY J. W. WILLIS BUND, F.L.S.

A HANDY BOOK OF
FISHERY MANAGEMENT

BY

J. W. WILLIS BUND, F.L.S.
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LONDON: LAWRENCE AND BULLEN, LTD.
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TO

THE MEMBERS

OF THE

SEVERN FISHERY BOARD,

IN WHOSE SERVICE I HAVE LEARNT WHATEVER
I KNOW OF FISH OR FISHING, AND FROM
WHOM FOR UPWARDS OF A QUARTER
OF A CENTURY I HAVE RECEIVED THE
GREATEST KINDNESS AND CONSIDERATION,
THIS BOOK IS DEDICATED.

Stevens Mar. 13|02 3/2

PREFACE

THIS book has been written (1) to point out the necessity for some change in the existing mode of managing our fisheries; (2) to show how dangerous even with the best possible intentions it is for Parliament to interfere with the order of nature; and (3) to show why from several causes a point in our fishing history has been reached when, if we want to maintain our salmon and trout, we must set to work to do it. All the conditions of modern life are against them; every change that is made in our rivers injures them, and, unless something is done at once, before the middle of next century the capture of a salmon will be an important event in most English and Welsh rivers, while trout fishing will be the luxury of a few millionaires. Salmon during the first quarter of the present century were regularly caught in the Thames; they have been driven out of that river, and will soon be driven out of every other.

If after having all the facts before it Parliament deliberately decides that the coarse fish are to be allowed to destroy the *Salmonidæ*, there is no more to be said.

The present state of things requires amendment. Our Fishery Boards consist of far too many members for any real work, and the members appointed are quite ignorant and do not care to learn. The mode of appointment is also capable of improvement. If no place can be found for a County Councillor on any committee he is placed on the Fishery Board. It is the refuge for destitute County Councillors.

Like the Wild Birds Preservation Acts, the Fishery Acts interfere with the natural state of things and have brought about artificial results that may or may not be beneficial—certainly not the results the framers of the Acts intended should be produced. It is only another instance of the danger of trying to effect an object by artificial means, leaving out of consideration all the consequences the alteration may produce.

Whether the principles of fishery management here advocated are right or wrong is a matter on which opinions will differ, but most persons will agree that the present system has not been a success and that there should be some change. After having presided over a Fishery Board for a quarter of a century, the principles here advocated seem to me to be the right ones. As to the mode of carrying them out there will be infinite differences of opinion.

J. W. B.

LINCOLN'S INN,
December 31, 1898.

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HANDY BOOK OF FISHERY MANAGEMENT

INTRODUCTION.

IT is now over thirty years since the inland fisheries of this country were placed under the control of Local Boards. About that time an idea was very prevalent that if anything was required to be done, the way to do it was to create a Board. The official mind of that date was permeated with the opinion, once form a Board and all things are possible. So Highway Boards, Burial Boards, Drainage Boards, Fishery Boards, School Boards, *et hoc genus omne*, came into being. It is true, the officials were right that under Boards all things are possible; but whether this is true in the official sense may be doubtful, and whether all has gone well under the very miscellaneous collection of Boards then formed is a question different persons may answer differently. Leaving all other Boards out of the question, it is certain that Fishery Boards have not answered the expectations of their founders. The great improvement in the fisheries that was to be brought about by their action has yet to come. At first it was to be expected mistakes would be made, the Boards were new to their work and had to learn their business ; but a quarter of a century should have furnished ample time in which even the densest Board might have acquired a slight knowledge of the elementary principles of fishery management. This, however, does not seem to be the case. Boards, if they are to be judged by their work, are as ignorant of the rules to be followed in the management of fisheries as they were thirty years ago. Their proceedings are based upon no system but that of how to do nothing. They do not promote the interest of the fisheries, except, perhaps, in some slight degree by stopping illegal modes of fishing. It is time that if anything is to be done a start should be made, but there does not seem to be any appearance that the Boards intend to make that start. If the members are asked why they do not do something to improve the fisheries of their district, the invariable answer is, "What can we do?" "How are we to set about it?" "On what principles should we work?" There is a good deal to be said in justification of these answers. Our present system has a strong resemblance to the blind leading the blind. Numerous as are the annual additions to the literature of fish and fishing, no one has as yet come forward to state in plain and clear terms the work of Fishery management. There is a good deal of useful information on the habits of fish and the modes of fishing to be found scattered about in the books on angling published each year. Much of it is not original, and a good deal is theoretical; but although most of the books agree that our present system is not perfect, none of them point out the imperfections, or endeavour to give any rules for the guidance of Fishery Boards, fishery proprietors, or fishery keepers, in the management and development of their fisheries. The result is that the fisheries are mismanaged and remain undeveloped. Some few Boards have gone so far as to publish instructions to water bailiffs; but these instructions are confined to stating what are, or (a very different thing) what the Boards suppose are, their legal powers, and what acts amount to breaches of the Fishery Laws. No Board has yet ventured to put forth any kind of guide to its members and servants, giving them a statement of the principles on which they ought to act and the reasons why certain bye-laws are made and what they are intended to bring about. As no one has attempted, or seems inclined to attempt, this task, this book has been written, not as being in any way a scientific or an exhaustive treatise on fishery management and development, but merely to furnish a plain statement of some of the fundamental rules which should be observed if any real attempt is to be made to deal with our fisheries on a definite system.

Most of these rules will appear so obvious that persons interested in fisheries will say they were aware of all of them before, and that there is nothing in this book they did not already know. This is certainly true. The object of this book is not to give new facts or to start new theories, but to try to indicate the line of action that our present knowledge of the subject shows should be carried out.

Two reasons have led to this being done.

(1) The long-felt need of some book to give information to persons who want to know some-

thing about fishery management; and (2) to induce those engaged in the preservation of our fisheries to take some intelligent interest in their work.

(1) In order to carry out these two objects an attempt has been made to give some plain hints how to distinguish the different kinds of fish in a river, first by their appearance in the water, and then from their appearance on land. Although cases often arise in which there is great difficulty in speaking positively as to fish, yet a very little trouble and observation will enable any one to gain a general idea of the fish in a stream quite sufficient for ordinary purposes. Strange as it may seem, the fact is, that many of the water bailiffs do not possess this knowledge. If they see a salmon leaping at a weir they can most likely recognise him; but they are quite unable to tell trout[1] from coarse fish, or to say, except that there are a number of fish in a particular part of the river, what those fish are. A water bailiff is given a warrant of his appointment, and sometimes, not always by any means, a book of instructions, and he is told in the terms of Nelson's celebrated signal that the

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[1] Where in these pages "trout" are mentioned, without the word "migratory," the reference is exclusively to *brown* trout (*S. fario*).

Board expects him to do his duty How that duty is to be done, what he is to look for, where he is to look for it, he is not given the smallest idea, and it is also quite possible his employers have not any to give him.

The Secretary for War, with the best possible intention, has lately been recommending all public bodies to employ the army reserve men, and doubtless Chairmen of Fishery Boards have received applications to put these men on as water bailiffs. It is very desirable they should be employed; it is true that to protect fisheries is the sort of employment for which they are well adapted; but it is equally true that they know nothing about it, and usually there is no one to tell them anything about it. The Boards have to pay them while they are learning their work, and the result is that a great deal of labour, temper, and money is absolutely wasted. The Boards are often dissatisfied that their water bailiffs get no cases; the water bailiff is unable to get any cases because he is ignorant of the first principles of his business: he does not know where to go to look after the fish; he wastes his time in watching places where the fish are not, and are not likely to be, and ends up by reporting there is no poaching going on, which is quite true, in the places he has been looking at, because the fish were not there to poach; while at the same time poaching is rampant where the fish are. The Board say the man is incapable or dishonest; the man says he has done his work, which is the case, but the fault is he has had no directions; he does not know what to do, and being accustomed to obey orders and not look beyond his nose, he has found out nothing, and the money he has been paid is absolutely wasted. Had he had some instructions, however elementary, it might to some extent have brought about a different state of things, and not led the Boards to say, as they do, that old soldiers are useless as water bailiffs.

If anything was really known about the habits of fish, a good deal of money that is now spent in the so-called improvement of fisheries would remain unspent. The money that has been laid out in artificial stocking—a very large sum—is usually so much money wasted, simply because the persons who spend the money will not take the trouble to learn one or two simple rules as to the habits of fish. The question of artificial breeding is too large a subject to be discussed here. It is only necessary to say that the popular idea that to turn annually so many thousand fry into a river without regard to the surrounding circumstances, either of the fry or of the river, is simply to throw away the value of the fry as absolutely as if the coins representing their money value were cast into the mud.

The number of persons — fishery owners, anglers, conservators, water bailiffs—who could say correctly when the different fresh-water fish spawn, where they spawn, and what quantity of spawn they carry, is not one in a thousand. We are all bound to know the laws, and, thanks to the late Mr. Mundella and "Whitaker's Almanack," there is an idea that coarse fish spawn between Lent and Whitsuntide; but that is all. Like most general ideas it has a modicum of truth, but only a very small modicum. If, for instance, a fishery owner were to say, "I am going to get rid of the chub in my water," it is doubtful whether he or his keepers, or the local anglers, would know the right time or the right way to set about doing it, as they would each be wholly ignorant of the habits of the chub; and if he applied to the Fishery Board, or even to the Board of Trade, for help and advice, their ignorance would be equally complete. In former years there was a class of men who could be found in most villages, and by most rivers, who knew every part of the river and almost every fish in each pool in it. They were probably poachers, and did not care whether it was fish or game they could put their hands on; but they had their use; they knew all about the river and its inhabitants. The greater restrictions that have been put on fishing in late years have caused this race to die out; for there is no place for them to obtain their knowledge; or, rather, our boys are now taught science and a great deal more at Board Schools, but are not allowed to acquire any practical knowledge. Their spare time they used to spend by the water—in poaching it may be, but in acquiring a practical knowledge of the habits of fish; now, thanks to their modern education, they spend it in betting, or similar means of improving their position in life. The man who knew most about trout and salmon of any man I ever met was a man of the old class. He was a Welshman, and had been sent to Lampeter, and was intended to have been a fisherman of another kind; but too great fondness for drink had proved a bar to his taking Holy Orders, for which his talents well qualified him; and as the Bishop would not ordain him, he took to fishing as a vocation. The rivers of the district for a radius of twelve or fifteen miles round where he lived he knew by heart; not a pool on the river but he was aware if it held fish and when it held fish, and could give a reason for each of his statements. For instance, there was a certain pool I often fished but could never get a rise; one day I went with him and he insisted on my fishing it. I did so, and after one or two throws was into a fish. I asked him about it, and his explanation was reasonable and the result of careful observation. Salmon, always, if they could, ran through the pool; there was a small fall about a hundred yards below, and another fall, a higher one, about half a mile above. In ordinary waters there were no fish in the pool; but if they could pass the lower and not the upper fall, as the pool was the only place in which they could lie between the falls, it was then a certain catch. You never, according to him, should fish this pool unless the water was up to the top of a certain stone and not over it. Fish it then, and you were sure of rising a fish in a particular part of the pool. I have always since followed his advice; and although I have not always got a fish, I have certainly risen one far more often than not. His knowledge of other rivers was the same; from long observation and knowledge of the habits of fish he knew where they would be, and when and how they should be fished for. I remember his great indignation when a man was brought up before the magistrates and convicted of fishing with salmon roe, but was treated very lightly. On my asking him the reason for his anger, did he think the man was not guilty? "Of course he was guilty," he said; "but why did you not give him the full penalty for fishing with roe at a place where there were no trout in that state of the water? The fool should have been taught a lesson." As a warning to conservators I ought to add the rest of my friend's history. I felt he was just the sort of man to make a water bailiff. I could not employ him myself, so I got him employment elsewhere. I warned him, and begged him not to disgrace me by poaching while an officer of the Board; and for a time he did well, and the Board said he was far the best of their bailiffs. They most unwisely gave him a holiday; he went to see his friends, and on his way back across the hills, he met with a sheep he thought would be useful, so he took it. He was tried and found guilty of sheep stealing, and sent to penal servitude. I went to see him in prison, and he reminded me that he had faithfully kept his promise and been a good servant to the Board. "But," he said, "I was hard tried at times; they knew so little and I could have done them so often, and so beautifully; and I would, but for you, Sir." I never felt more sorry for any one.

I quite agree that there are not many persons like my friend; but as it is possible persons not possessed of his knowledge or of his honour may get into the employment of Fishery Boards, it is just as well that there should be some one on each Board who has a slight general knowledge of the habits of fish; and if such a person will follow out the points mentioned in these pages he will be able to form some idea as to what his servant is doing or leaving undone.

It is very desirable that each of our fishery districts should be managed on some principle, and as far as possible on the same principle. It may well be, and I believe is the case, that we have not yet arrived at the knowledge of what is the best system of management; and I am inclined to believe that there is no system universally applicable, but that the local circumstances of each district require special modifications. To some extent fishery management is like farming, the system to be followed is the one best adapted to the country; but there are certain general principles that underlie all systems, and are of universal application, and these should be applied rigorously to all our districts. We want to know with regard to the different rules—which are of universal, which are of local application. At present we content ourselves with having no rule and no system, but act on a sort of go-as-you-please method, which only ends, as every one must see it would do, in failure. Certain rules as to water, food and preservation are of universal application, so are also the proportion of fish to food, so are the proper provisions as to spawning and protection of spawning fish and fry. If certain points are to be especially insisted upon, such as the preservation of *Salmonidæ*, then a knowledge of their enemies is also essential. It is precisely on these points that Fishery Boards and their servants are most ignorant.

It is, however, not only fishery owners, Fishery Boards, and their servants who want this knowledge. There are a large and annually increasing number of persons who rent fishings, and who would be glad to be able to ascertain how much, if any, of the glowing terms of the advertisements of fishing that are always to be met with they can believe. Before renting a fishery it is of course desirable to obtain properly certified lists of results of previous seasons, and (if possible) to communicate with the previous lessee. But if an intending tenant has any knowledge of fish a personal inspection of the river should also be made.

If a person will walk down a river and use his eyes he will most likely, if he can distinguish the fish in the water, and can see certain signs and traces on the river banks, get some idea of what the water is and what fish there are in it. This much he may feel sure of, that while it is quite possible the water may be better than he thinks it is, he can tell if it is really worth renting at all. If valuable trout fishing is offered him, and he sees no fish there, or only chub, he will know that the rent of that water should be reduced at least 75 per cent. below the sum asked for trout fishing. If he sees that at one side of a pool the bottom is worn very smooth and only a large stone here and there, while above and below the place the sides are rough and there are numerous stones lying about, he will not be wrong in thinking that the natives are not wholly ignorant of the use of the draught net. If he sees round the pools the boughs or bushes at the top of the holes broken and the bushes generally having an appearance that they have been beaten, he can assume with some confidence that the art of bush netting is practised. If he sees any dead fish about it will be worth while to get them out and to look at them carefully, for they may disclose the use of night lines, or, what is worse, pollution; and if as soon as he appears on the bank the fish scuttle off as if the evil one had come, whether their view is right or wrong as to himself, he will know that the fish are not ignorant of his devices, and that he will have to fish up stream and if possible with a dry fly. These facts are easily ascertained by one or two careful observations if he goes himself, and knows what to look for. If he does not, he will go back as wise as he came, and very likely take the water as it looks so nice.

(2.) There is another reason for a book of this kind. Boards of Conservators, in order to properly carry out their duties, require to have one source of information which they do not now possess. They are all very fond of making bye-laws, but very few of them have any knowledge how the bye-laws work, and whether they really carry out the object for which they were made. The only persons who can really give this information are the water bailiffs; and speaking from thirty years' experience of water bailiffs, it is hardly ever that they do give it, probably because they have not got it to give. They seem to believe—and the way they are instructed tends to foster such belief—that their great duty, their only duty, is to detect breaches of the law; this is an important part of their duty, but it is by no means the whole. It is equally important to know precisely the effect of the law, as to punish persons for the breach of it. For instance, to prevent the netting of certain fish, a bye-law is passed altering the size of the mesh. But a mesh that would let through a pound trout would also let through a three pound pike. The bye-law might, therefore, have the desired effect in preventing the trout being caught in the net, but it would not really improve the river, as it would only be encouraging the pike, and, while not increasing the stock of trout for which it was passed, greatly increase the number of pike. Many Boards would think it derogatory to their dignity to explain to their bailiffs why they made certain rules, assuming they could give any explanation, which is by no means certain in all cases. Yet until the bailiff knows why he is doing this particular work he will not be able to give any useful information as to its effect, and the Board will be going on in happy ignorance, often doing real injury to the river by foolish bye-laws, while they honestly believe they are doing real good. It is quite true that as regards a number of matters the bailiffs have to carry out their orders without any question or reasoning; but it is equally true that Boards often miss very valuable information by not availing themselves of the practical knowledge which their bailiffs might acquire for them. If any systematic preservation is to be carried out, it can only be done in getting from those who see the practical working of the system full information, as to its merits and failures. Mistakes must be made, probably more in fishery management than in anything else; but there is no reason why mistakes may not be utilised and turned to good account.

The points to be considered are, first, to get a clear knowledge of the fish usually met with, so as to be able to distinguish them whether in or out of the water: some general rules to assist in doing this are stated in the first two chapters. They are put forward with some diffidence, as the subject of the distinction between salmon and trout in their early stages is one on which few persons agree.

There is on record the case of one of Her Majesty's Inspectors of Fisheries who in an unguarded moment gave certain infallible rules by which young salmon could be distinguished from trout. A poor misguided person, who believed that everything the Queen's printers publish must be good law, caught a small fish, applied the Inspector's rules that had been laid down for his guidance, kept the fish instead of returning it to the water, and was charged, convicted, and fined for unlawfully taking the young of salmon! I do not venture to lay down any rule, for I do not know a sure one; but I have mentioned a number of points which, if they are present or absent in a particular fish, would lead me to form a very strong opinion one way or the other, and one on which I should not hesitate to act. I cannot put it higher. Fortunately these very doubtful cases are of rare occurrence, and a person who will look for certain signs will find that in most cases he is right in his diagnosis of the fish in question.

Having ascertained what are the fish to be met with, the next point is to know something of their habits, their food, and the places they frequent at the different times of the year, their time of breeding, and the conditions under which they breed, so that if it is desired either to increase or to destroy any particular class of fish, the necessary steps to be taken, and the best times for taking them, may be known and understood. For instance, if it is desired to keep roach and dace from ascending a stream, a close watch should be kept at weirs and mills in May and June; if pike are to be kept down, the ditches and backwaters should be searched for them in February and March.

Having got some idea of the fish and their habits, the next step is to learn something about the river: first and foremost, its water supply, how far it is constant, how far variable, and how far ought fish to be allowed to run up, what are the natural and artificial causes for variation in the supply, should they be altered if possible? can they be altered if desirable? Then follow the two great modern difficulties as to fisheries—the abstraction of water from, and the pollution of, rivers. It is useless to spend money and time in the improvement of our rivers if the fish are to perish either from absence of water or presence of pollution. Having ascertained the condition of the rivers as to water, the next point to consider is the stock of food, taking all the year round what is the food supply. The question is a difficult one, and does not admit of a definite answer; but one sufficiently near for practical purposes can be obtained; and when this is done then comes the point of how to increase it if insufficient.

As the question of the stock of fish depends on the food supply, steps should then be taken to find out what the stock is and what changes should be made, should one class of fish be encouraged and the other discouraged; in fact, what is to be the future of the river and the steps to be taken to increase or diminish certain kinds of fish. One thing may be taken as certain, a choice must be made, it is impossible to have all sorts and conditions of fish.

In connection with this comes the question of artificial breeding and stocking—when and in what circumstances it is beneficial, and when it is useless.

These points furnish the chief items to be considered in fishery management; and having stated the principles on which each depends, a statement is made of what should be looked for and what should be done during the different times of the year by those who really want to follow the business of fishery management. It may be truly said that, like other branches of estate management, farming, or gardening, there is always work to be done, work for every day in the year, and that success or failure will depend in this as in other matters on whether the daily work is done or left undone.

CHAPTER I

TO DISTINGUISH FISH IN THE WATER

In dealing with fishing the first thing to learn is to be able to recognise the different species of fish, so as to be in a position to form some idea as to what fish are in the stream. A very little practice will enable a person to do this with almost absolute certainty. The fish that will usually be found are of two kinds, *Salmonidæ* or game fish—salmon, brown trout and grayling; and coarse fish—gudgeon, minnows, barbel, chub, roach, rudd, dace, bream, perch, ruffe and pike.

In the water the first great distinction is that speaking broadly, the *Salmonidæ* swim deeper than the others. Coarse fish are much fonder of basking, especially if the water is deep, than game fish. In shallow water both are often found at about the same depth, but in a deep pool the trout lie low, while the chub come to the top. If a reason is wanted for this difference the formation of the teeth may be given. A chub has no teeth in his mouth; he *sucks* in his food, and has to be near the surface to do this. A trout has his teeth in his mouth; he catches his food, and has time to dash up and seize it. If a practical illustration of the difference is required, go to a river on a hot day and have a look at a chub hole. You have to go cautiously, as a chub is easily frightened; but get into a place where you can see and remain still, and you will see a chub come lazily along sucking in the various things that pass, and, if he does not like them, spitting them out. A trout never takes things on approbation: he makes up his mind that a fly or insect is worth taking, you see something come from the deep, as the insect is making circle after circle on the water, a swirl caused by the tail of the fish descending, and that is all. Any one who takes the trouble to spend half an hour in watching the way the two fish feed in deep water will be able to tell without seeing the fish whether a rise is caused by the suck of the chub or the swirl of the trout. In shallow water it is different;

it requires a very practised eye to say whether a two-pound fish feeding on a shallow is a chub or a trout, when the fish cannot be seen and the rise is your only means of judging; each takes the flies that come over him, and there is little difference to mark the rise in the water except that you more often see part of the trout's head than you do the chub's. The broad rule is that a trout seems more in earnest than a chub: he rises as if he wanted the substance for food; the chub rises as if he was trying an experiment.

As a rule the fish over one pound that are seen in our rivers are either salmon, trout, grayling, pike, chub, roach or perch. Salmon may usually be told by their size; it is, however, easy to mistake a large migratory trout for a small salmon; but this does not often occur, and for practical purposes, if a river is a salmon river, or rather a river in which salmon are found, and a large fish is seen rising or swimming deep down in the pool, the chances are it is a salmon. If it is thought that there are salmon in a pool, it is worth while to watch it closely, especially early in the morning and late in the evening, and the probability is that the watching will be rewarded with positive proof, as at these times a salmon often jumps right out of the water for joy, exercise, or some unknown cause, and they then cannot be mistaken. This only refers to the summer; during the breeding time no fish is more easily seen than a salmon.

Trout are generally seen lying deep in the water, and as a rule alone. Coarse fish usually go in groups, brown trout never. Each trout acts independently and has his own beat; and if a dark-looking fish is seen in the same place day after day, the odds are considerable that it is a trout, nay, more, if the fish is caught, it is almost certain another trout of about the same size will very soon establish himself in the same place. A dark fish deep in the water, too small to be a salmon and constantly on the same spot, may be put down with fair certainty as a trout. The shape, the dark colour and the seeming immobility of the fish are the outward visible signs of the trout, if others are wanting.

A grayling is harder to tell. Unless his great dorsal fin can be made out, which is seldom the case while he is in the water, he is often a puzzle. As a broad rule the best test between him and a trout is that the trout has learnt the lesson so many of us failed to learn as children—he can keep still. This the grayling cannot do. He is always moving; he may not move any distance, he often keeps on a spot a foot square, but he is always hovering as it were over it, he never settles. He is a fish with the fidgets. While it is quite easy to mistake a piece of stick for a trout, no one would ever mistake a grayling for anything but a fish. It is sometimes hard to distinguish between dace and grayling when the grayling are small, but if they are large, the best test to apply is, does the fish keep still or not? If he does not, *probably*—it cannot be put higher—the fish is a grayling.

It is difficult to set down on paper any rule for distinguishing *Salmonidæ* when in a river that is more than a rough help to recognise them: one hour on the river and seeing the fish is worth more than a week's "poring over miserable books"; no scientific description here will avail, all has to be learnt at the river's side, and there are a hundred little things a person will observe for himself that will make him certain what a fish he sees is. The rough tests are—size for salmon, immobility for trout, mobility for grayling; and these will, if attended to, help an observer to construct his own rules, which will be his best guide if they are formed on careful observation. There is only one caution that cannot be too much insisted upon. In nothing so much as in the habits of fish is the rule that circumstances alter cases to be remembered. Knowledge picked up on one river does not always prove correct on another. While under certain circumstances fish will do certain things, alter those circumstances and the habits of the fish are also altered. Next to the danger of knowing nothing, comes the danger of narrow local knowledge, and to dogmatise on the habits of fish from the experience of one stream is the sure means of making fatal mistakes. Local habits of trout can easily be pointed out, and the knowledge of them is most valuable, but it must not be assumed it is of universal application.

What has been said relates to mature fish; the habits of some of the immature *Salmonidæ* differ very much from those of the mature. Young salmon before they enter the migratory stage have much more resemblance in their habits to young trout than to any other fish, and it will require a man whose experience or knowledge is very great to be able to say with anything like accuracy which is which. For the first year it may be said the two are quite undistinguishable in the water; after that, it may be said the salmon keep more together than the trout; a shoal of small *Salmonidæ*, of from two to four inches, are usually salmon, but very often there is an odd trout or two with them. One good practical rule is this, that it is far more likely if the fish are in shoals, or if one or two are together, that they are salmon than trout. It is the commonest thing possible either with a fly or a worm to catch a number of samlets off the same spot on a ford. It is equally common to catch small trout at different places on the same ford; but it is by no means so common—in fact it is very uncommon—to catch a number of small trout from the same place. As the fish grow bigger, they are more easily distinguished: the young salmon keep near the bottom and appear to feed more on the bottom than the trout; the difficulty then comes, if there are many gudgeon in the river, to say if a shoal of fish on a ford are samlets or gudgeon: this can be generally solved in one of two ways—the best is to watch them, and if any of them rise at a passing fly, they are samlets; if they take no notice of flies, they are probably gudgeon; the other way is to note the colour, the gudgeon is usually lighter in colour than the samlet. The gudgeon never gets darker than a pale grey, the samlet begins at the colour of a book newly bound in law calf, and in time, like the book, passes to a deeper hue. But in all these cases there is only one really satisfactory test, that is, to catch one or more of the fish. Observations of fish in the water only give a general idea, and cannot be relied on as establishing facts.

One other way to ascertain if young fish are salmon or trout is their mode of feeding. If a fly thrown across a ford is drawn up against the stream and a salmonoid fish takes it, the probability is the fish is a samlet, not a trout. This is well known to regular samlet fishermen, who by this mode of fishing will fill their baskets, while a novice will not catch one, and it is from this and the voracious habits of the little fish that young anglers, who almost invariably fish down stream and draw their flies up against the stream, catch more samlets than trout. A magistrate who was told a man was fishing in this way and was therefore suspected and searched and found with samlets on him, would perhaps attach no importance to the way the man was fishing; while if it should be urged in his defence, as is always done, that the accused did not know the difference between samlets and trout, one of the points to be considered in deciding defendant's knowledge should be his way of fishing, especially if he is an old hand. Another way samlets can be recognised from other fish is by the way they will take a worm. Coarse fish as a rule nibble at a bait, a samlet does not; he takes it into his mouth, shakes it as a terrier does a rat, and bolts it: give him time and you are certain to catch him; give a gudgeon time and you find your worm nibbled away.

Coarse fish are easier to distinguish. No one who has ever seen a pike can mistake the pointed head and the dorsal fin so far back. It is rather an Irishism to say no fish can be so easily known from making no stir in the water, but so it is. A pike darts off; you see something has gone, or, rather, you perceive and feel something went, but you see nothing, for as a rule a pike does not disturb the surface. It is the straight rush that marks the pike.

A perch cannot be mistaken if you once learn to recognise him; but it is only by sight that he can be recognised; he makes no sign in the water, usually feeding well under the surface. The black and white stripes, recalling the remark the sailor made when he described a zebra as a donkey with a jersey, will not fail to identify a perch as the fish with a jersey. Chub again cannot be mistaken; the ruddy colour of the pectoral fin and the black mark on the tail, which show so clearly in the water, make a chub a most easy fish to identify.

The red fins on the breast also serve to identify the roach; but if there is any doubt about them, which there ought not to be, it will be removed if they are watched for a short time. Roach when undisturbed go through most wonderful manœuvres, some swimming with their heads down, some with their heads up; no other fish practise the same tricks. Their shape and their red fins make them most easy to identify. One word should be said here as to rudd. It is impossible in the water to tell rudd from roach, and any attempt to do so must end in failure. The only possible test is size, roach in most places running to a larger size than rudd. But the fish are so alike that it is not, so far as preservation is concerned, a matter of great importance to distinguish between them in the stream.

Dace may be known in the water in a regular way as the fish that do not present any of the characteristics of other coarse fish. If a fish is seen without any distinctive sign, the chances are it is a dace, and the best description of it is a dark-backed fish without any special marks. Dace and chub are the two most common of coarse fish, and if a coarse fish is not a chub, it is most likely a dace. There is a difficulty in grayling streams in telling a large dace from a small grayling, and only the knowledge which comes from long habits of observation will enable a person to speak on the subject with any certainty. Unfortunately, dace are so much more common than grayling that it is safest to assume in case of doubt that the fish are dace and not the rarer kind.

Bream are seldom seen until they are caught, as they are usually only found in deep holes. I have not had sufficient opportunity of observing them to say what are their distinguishing points in the water. When they are once caught, any one possessed of the meanest capacity cannot fail to distinguish them, although it requires an expert to say to which of the two kinds of bream that are found in our waters any particular specimen belongs.

Barbel are also a fish I know very little about; they are not found in many rivers. The best description I can give is a large fish grouting on the bottom. The only fish they could be mistaken for are possibly large trout or small salmon, and the test to apply to them is that barbel have a habit of moving about and grouting on the bottom.

Bleak may be told at once; they are the only surface feeders, whose backs look green in the water. No one can possibly mistake them who remembers this.

The smaller fish that frequent the shallow pools are more difficult to distinguish. A grey fish with spots that keeps on the bottom may be one of three kinds,—a gudgeon, a samlet, or a ruffe. Gudgeon and samlets are very difficult to tell apart, being in the water about the same size and shape, and are often found in the same place—a shallow pool at the end of a ford. The gudgeon moves slowly, feeding on the ground, and always gets his head *over* what he eats. The samlet moves quickly, he is, like the devil, always seeking something he may devour, and takes it just as it comes, neither from above nor below habitually. A very short study of the habits of the two fish in a pool will enable any one to be pretty certain which are which. The ruffe is a difficulty in colour; he is in the water more like a gudgeon, but he differs in size, being as a rule smaller, and in shape being thicker, and also in the way of taking his food. He does not get his head over it, like a gudgeon, he does not bolt it like a samlet; but he nibbles at it, and lets it go, and then nibbles again.

Minnows may be known more from the places where they are found, and from the fact that they are usually in shoals in still water near the side in a pool with only a slight depth. But, if a good look can be got, and a shoal of small fish with black spots on the sides, and occasionally with red on the stomach or sides can be seen, they are minnows.

The best possible way of becoming familiar with the three kinds of fish is on a bright day to try some pool, where they all are to be found, with a red worm; and, from the nature of the bite, at the end of an hour you will have a pretty good idea which is which, especially if the water is clear enough to allow you to watch your fish and your bait.

The rules above stated, with a little practice, will enable any one with ordinary powers of observation in a short time to say what kinds of fish there are in any given piece of water, so as to know what he has to deal with in preserving the river. These are rules that will apply all the year through, and wherever fish can be seen. But if any one wants to become perfect in the knowledge of fish, he must study them at all times, and he will find that, having regard to the different times of the year, there are other rules which will enable him to speak with greater certainty. At spawning time no one can mistake trout or salmon on the beds. In March or February a large fish up a backwater will be nothing but a large pike or an old kelt. The black mass of fish to be seen at the side of a pool on a sunny day in April must be dace. The group of fish dropping down stream in May in a fresh, and rising at everything as they go, can only be smolts going seaward.

One or two kinds of fish have not been mentioned, mainly because they are not often met with in rivers, and my experience does not extend to them. Tench are mainly, if not wholly, pond fish and keep so much on the bottom that even if a pool is full of them, if there is any depth of water, they are very rarely seen. But if any one wants to know if there are tench in a pool, let him go and sit beside it some warm evening in June just before it is dark, and then, if he hears a splashing among the water plants, and sees the leaves disturbed, he can rest quite certain that there are tench in the pool, and that they are spawning.

The disturbance they make always seems out of all proportion to the result.

Carp again are a fish that I have never seen in rivers. On a hot day their behaviour in a pool is not unlike that of chub. But they can be at once distinguished from every other fish by their large scales. They have many points of peculiarity about them; but although a few years ago some enthusiasts recommended the cultivation of carp as a remedy for agricultural depression, they are not a fish that either a Fishery Board or a person taking a fishery would trouble himself about.

The fish that have to be dealt with are on the one side salmon, brown trout and grayling; on the other, chub, roach, rudd, dace, bleak, gudgeon, pike, perch and ruffe, with occasionally bream and barbel. Enough has been said to enable any one who cares to do so to distinguish them in a river. Eels are distinguishable by any one; neither lampreys nor lampern take bait, and their habit of clinging to stones by their mouths at once identifies them.

It is always desirable to get some idea of the fish that are likely to be seen, especially until after some little practice in distinguishing fish. There are very few streams in which all sorts of fish will be found, and it is usually fairly certain that what will be seen in a coarse fish stream are chub, roach, dace and pike, or in a trout stream, trout, dace and chub. If there is much water in the stream it is waste of time to try and see more than the fish feeding at the surface. The time for seeing the other fish is when the water is at its lowest. There are two things to be remembered if fish are to be observed—(1) Go by yourself, as otherwise you will not be so likely to keep still, and stillness is essential; (2) Use all the patience you have. If you are to be able to speak with certainty, it is by patient looking, not by a mere casual glimpse; never go away satisfied until you feel sure that by staying you will find out nothing more. If you are observing fish, it is not the distance you have gone over that is to be counted, but how much in that distance you have thoroughly observed. One ford or one pool thoroughly done is better than a mile or two casually looked over.

CHAPTER II

TO DISTINGUISH FISH OUT OF THE WATER

IT may seem an extraordinary statement to make, but it is perfectly true, that in doubtful cases it is harder to distinguish a fish out of the water than a fish in it. In the latter case all that may be wanted is a general idea of what sort of fish frequent the river, but when fish are examined out of the water a precise statement is required. Usually the cases of difficulty are few, and relate more to the diversities of species than anything else ; but although few, they are most difficult, and, in some cases most important. For instance, the all-important distinction between young salmon and small trout : it is an offence to catch the one it is not to catch the other.

Roughly, there are several broad rules that will enable an accurate answer in most cases to be given to the question what a particular fish is.

The fish usually met with in our rivers are twenty-seven in number.

1. *Percidæ*—perch, ruffe.
2. *Cottidæ*—bullhead.
3. *Gastrosteidæ*—stickleback
4. *Gadidæ*—burbot.
5. *Pleuronectidæ*—flounder.
6. *Murænidæ*—eels.
7. *Cyprinidæ*—carp, barbel, gudgeon, roach, rudd, chub, dace, minnow, tench, bream, bleak loach.
8. *Salmonidæ*—salmon, sea-trout, trout, grayling.
9. *Esocidæ*—pike.
10. *Cyclostomi*—lampreys, lampern.

This is not meant in any way to be an exhaustive or a scientific list; several species are left out and the arrangement is not that now adopted.

A bullhead cannot be mistaken; the shape of the mouth, the flat head, the colour and the small size will at once enable him to be recognised. The small size of the fresh-water form of stickleback and the spines are an unfailing guide. The flat form of the flounder and the fact that it is the only fish of the kind found in fresh water at once identify it.

The lamprey and lamperns are unmistakable, from the appearance of the gills, like a row of holes on each side. The large lamprey can be told at once by its size; it is never *under* 18 inches, its colour is grey with black markings. Its liver is green. It is only found in the adult state in rivers in May and June, when it comes up to spawn. The lampern, the smaller form, rarely exceeds 24 inches; it is brown on the back, white on the belly, and it is only found in any quantity from October to March.

The third form is often called the Pride, and never exceeds 12 inches, usual size being about 6 inches. I am inclined to think this is only the young of one or other of the two preceding species. It certainly migrates seawards in the autumn, and is often caught in the eel-nets with the descending eels. I have never been able to ascertain if there were two distinct species of it corresponding to the lamprey and lampern, or, if these were not the young of some anadromous form, as they certainly migrate in large numbers seawards in the autumn. For the purpose of distinction size is quite sufficient.

This disposes of five of the families, as to them no question can arise; with regard to the others the first great rule is to look at the fins on the back.

(*a*) If there is only *one*:—The fish is either one of the *Cyprinidæ* or a pike or a ruffe. A pike can at once be told from the position of his back fin; it is, in fact, so near the tail as not properly to be a back fin at all. A pike is the only fresh-water British fish that has his dorsal fin in that position, and this forms a safe sign as to what the fish is. A ruffe has one back fin, but it is the only British fresh-water fish that has one back fin, the rays of which project and are spiked. If you wish to make sure, extend the *one* back fin of any fresh-water fish that has only one, and while it is extended take the fish into your hand; placing your hand on the extended fin you will receive a prick that will have the same effect on you as beating the bounds used to have on small boys.

(*b*) If there are *two* back fins:—Has the second, the one nearest the tail, any rays? If so, the fish is a perch; it is the only British fresh-water fish with two back fins, both of which have rays.

If there are no rays to the second back fin then the fish is one of the *Salmonidæ*.

(*c.*) If there is one continuous fin from the back to the tail, the fish must be the burbot, the only one of the *Gadidæ*, which is found in British rivers.

So the fin test, whether the fish has one or two, or a continuous back fin, will at once enable it to be said to which family it belongs.

Between the two *Percidæ*, the perch and the ruffe, there can be no mistake; as in the perch the rays of the *front* back fin project, in the ruffe the rays of the *only* back fin project; so that for practical purposes the question is narrowed down to whether there is a second rayless back fin; if there is, it is a salmonoid, if not, it is a coarse fish. So far it is possible to speak with certainty, and this test is one that any one can at once learn; it is one of those where even the water bailiffs, "though fools, cannot err."

The difficulties arise in distinguishing the members of the different families from each other. Of these families only three have more than one freshwater representative. The *Percidæ* have two, the perch and the ruffe. In addition to what has been said about the rays of the back fin, the perch has a black patch on his back fin on the end next the tail. This the ruffe has not. The colours are most distinct, the dark green of the back and sides, the black bands, the red pectoral fins, make the perch a most conspicuous fish. The ruffe has none of these marks; he is slimy, and has a beautiful sapphire-like colour about the eye that no other fish possesses. The size also furnishes a distinction. Ruffe are on the average smaller than perch.

If, as is often the case, it is wanted to find out what fish have been taken, the scales of the *Percidæ* are an unfailing sign; no other British fresh-water fish have scales of the same serrated form as these two fish.

The great difficulty in saying decidedly and definitely what a particular fish is mainly exists in the case of the *Salmonidæ*, for it is really of little practical importance to distinguish a roach from a rudd or to be able to tell the different species of bream, and the distinctions run so fine that it is very difficult to lay down any general test. As to grayling there can be no doubt; the huge back fin without spiked rays is an outward and visible sign that renders it impossible for a mistake to arise.

The greatest difficulty is in distinguishing between young salmon and young trout. Of course, as to a full-grown salmon and a full-grown trout in season no one ought to be mistaken; but between a salmon kelt and a migratory trout kelt, or between a very large trout kelt and a small salmon or grilse kelt distinction is not so easy. Two negative rules, or rather indications, may be safely laid down: (1) Do not trust too much to colour; (2) do not place too great reliance on size. A very large fish will probably be a salmon; but between a 5 lb. grilse and a 4 lb. trout it will not do to consider size. If the fish can be examined so that the cæcal appendages can be counted, the teeth considered, the fins, rays, and scales numbered, it is not difficult to say with tolerable confidence which is which; but if either the fish is so decomposed that it cannot be examined closely, or only a part of the fish is there to be examined, it is much more difficult. For myself, I never speak positively on a whole fish, still less on part of a fish; but I have heard men who know what they are talking about, swear and swear positively to the species of fish, having only seen a part. I once tried an appeal against a conviction for being in possession of unclean salmon; the defence was the fish was a trout, the water bailiff never saw the whole fish, all he saw was a part, the tail half, boiling in a pot on the fire. He swore to it as being a salmon, and stuck to it, the only reason he gave was, " Don't you think I know a salmon when I see it?" I fully believe he was right that the fish was a salmon, but I could not bring my mind to act on his evidence; he would give no detail as to the rays of the tail, the scales, the colour of the flesh, or anything connected with the fish, only his assertion it was a salmon. My brother justices believed him, and affirmed the conviction, in spite of some most positive swearing by the men who had caught the fish that it was a trout; but they also did not condescend to details. I did not believe them, but I felt that the assertion of a water bailiff without anything that amounted to confirmation or enabled an opinion to be formed, was not enough for a conviction. It is, however, hard to say what more an uninstructed man could state. He probably did not consider or had never observed, that there was any variation in the tails of the two kinds of fish, and certainly never looked at the scales.

The following are the principal points of difference:—

I. External. (*a*) In the salmon the *tail*, when the fish is young, is forked; but it gradually becomes squarer as the fish grows older, until at last it is practically square. In the trout on the contrary as it gets older the tail becomes convex rather than square.

(*b*) The outside gill cover, in the salmon is shaped differently to that in the trout: for instance, if a piece of string is placed at the most projecting point of it, and drawn in a line to the snout, in the salmon it will pass *through* the eye, in the trout it will pass *below* it.

The above form the readiest tests for distinguishing salmon from trout, but they must not be looked upon as in all cases infallible.

(*c*) The number of rays in the fins. These vary considerably, but, as a rule, salmon have fewer than trout. The usual numbers are—

	Salmon	*Trout*
Dorsal	13–14	12–15
Pectoral	13–14	13–15
Ventral	9	9–10
Anal	11	10–13
Caudal	19	18–19

These are the average, or it may be said the standard number, a slight deviation from the standard would not be a safe ground to found an opinion on. Yet, if the number of rays in all the fins was higher than the salmon average, and that concurred with other tests, it would strengthen the conclusion arrived at by all the facts.

(*d*) The scales. There is greater variation in the number of scales in salmon than in trout.

Counting *along* the lateral line the standard number in salmon is from 120–125, in trout from 115–130, counting *above* the lateral line 21–26 in salmon, in trout 24–27, counting *below* the line in salmon 19–29, in trout 28–32.

These are the chief *external* points for examination; colour cannot be relied upon as a test although it is a matter that may be fairly considered in conjunction with other tests. The following are some of the points as to colour.

(*e*) A fresh-run salmon in condition is usually oı a steel blue with black spots. If it has been long in fresh water, a reddish-brown shade comes over the blue. If fresh-run from the sea, when first caught, there is a sort of violet colour or shade on the back.

"A well mended kelt," fresh caught, has a blue colouring, but it is lighter and it has not the violet shade when caught; the fish is thinner than a fresh-run fish, and the shades not so deep. It, perhaps, can be best expressed in this way: the fresh-run fish looks like a well fed fish untrained, the kelt like a fish that has been trained.

As the season advances, the colours of the fish alter. The males become red, with orange-coloured marks on the gill-covers, and sometimes on the body. The females become dark in colour. The change in colour varies with the development of the spawn, but the development of the ova does not seem to affect the colour to anything like the same extent as the development of the milt.

Large migratory trout change in colour in some degree like the salmon; but the spots on the former are more marked and more intense, and the male trout never loses all his carmine spots. As has been said, colour cannot be used as a distinguishing test, but still it is most useful to observe colours in salmon, as they give very important help in many ways; for instance, as to the time the salmon has been in the fresh water. A discoloured fish may furnish most valuable aid in the detection of poaching. If seen on a stall, it at once gives rise to the inference that some fresh-water netting has been going on. But to attempt to say by means of colours alone what is the precise species of fish, or whether it is unclean or unseasonable, is impossible. In one sense, but in one in which certainly the

Latin poet did not use the word *color*, there is no safer rule than "*nimium ne crede colori.*"

II. The *internal* points to consider are—

i. The number of vertebræ. Here again there is more variation in number in the trout than in the salmon. The standard for the salmon is 59–60; for the trout, 57–60. This again is not a conclusive test, but only one that can be used with others.

ii. The number of pyloric cæca or cæcal appendages. The number in salmon is from 53–79; the number in the trout from 33-90. Probably this is as conclusive a test as any; if the number is below 40 or above 80 it may be said with confidence that the fish is a trout. The cæcal appendages are blind tubes or involutions of the gut, situate at the commencement of the small intestines, opening internally.

To sum up, the points to be considered in determining whether a fish is a salmon or trout are:—

1. Size—general appearance—colour.

2. Scales—the size of these on the caudal part ot the salmon being larger.—Number along, above and below the lateral line.

3. The outside gill cover—whether a straight

line drawn from its extreme point towards the snout passes through or under the eye.

4. The number of rays in the fins.
5. The number of vertebræ.
6. The number of cæcal appendages.

If all, or the majority of these, point one way, they may be accepted as fairly denoting the species of fish. If they are divided, then there is a difficulty, and it becomes really a mere matter of expert opinion. In such a case external circumstances, such as where the fish was caught, how it was caught, when it was caught, should be considered. It will, however, be found that it often happens that the difficulties and differences arise mainly from the want of accuracy in the observations. To a man not accustomed to the work, counting scales, fin rays, vertebræ and cæcal appendages is not easy work. To do it with absolute accuracy is very difficult. In nine cases out of ten it is done inaccurately. I remember trying with the late Dr. Day to count scales, rays and vertebræ of some trout. We counted each fish some four or five times and neither of us ever arrived at the same result, and once or twice our results differed from our own previous countings. The safe rule for Fishery Boards is always to have such work done by an experienced person; not to trust it to a water bailiff. There are not three water bailiffs in England and Wales who possess the knowledge how to do it, or who, if they have the knowledge, have the skill; or who, if they possess both, could be relied on to count with accuracy. Always, when possible, have the work checked by some second competent person. It will be a saving of expense in the end, as all orders of magistrates are now liable to appeal.

With regard to the distinction between young salmon and young trout, the matter is more difficult; and it is extremely hard to lay down any rule that can be relied upon in all cases. Nowhere is the danger of a little knowledge greater; and although I have been asked over and over again, by persons who fancy they know a great deal, to have endorsed on rod and line licences a note showing the precise means of distinguishing samlets from young trout, I have always refused, as I have yet to find the one safe invariable external sign distinguishing the two fish that every one can recognise. People forget that in this question five kinds of fish have to be dealt with: (1) young of salmon (*S. salar*), (2) young of migratory trout (*S. trutta*), (3) young of the brook trout (*S. fario*),

(4) hybrids between salmon and migratory trout, (5) hybrids between migratory and brook trout.

1. The first point to note is that all these fish have usually bands or finger-marks, but that the brook trout have fewer and fainter marks than the migratory trout, so that while it is not a conclusive test to say that the one fish, the trout, has not finger-marks, and the other, the legal "young of salmon," has, it is a good practical rule for the angler to act upon, never to keep fish on which the finger-marks are well developed; if he does, he may get into trouble. For the water bailiff, the development of finger-marks should put him on further inquiry.

2. The next point to notice are the spots. Carmine spots on the young of salmon are usually *above* the lateral line; it is very rare, but not unknown, to get them below it. Here, again, the angler who wants to avoid bother, will only keep doubtful fish with such spots below the lateral line. If he keeps others, he may be convicted.

3. In the young of salmon the spots on the large back fin are few and appear without order, in a trout they are in rows between each fin ray. This, however, is only an indication, and by itself would mean very little.

4. In young of salmon usually the second dorsal or dead fin is without any defined red spot or line, but a reddish colour sometimes occurs. In the trout defined red spots and lines are of ordinary occurrence.

5. In the trout there is often a white border to some of the fins. In the salmon this is very rare.

6. On the gill covers of young salmon the only spots are usually one or at most three black ones. Trout have more.

7. The pectoral fin of the young salmon will reach two-thirds of the distance to the ventral fin; the pectoral fin in the trout will fall short of this. The shape of the two fins also differs, the young trout being more rounded than the young salmon.

If all these seven distinctions exist it may be said with some degree of confidence to which species the fish belongs. If only some, the last is the one to which I attach the most importance,—the size and shape of the pectoral fin. But I would not, if everything else was against me but that, swear that the fish was a samlet. Fortunately, these fish can always be preserved at little cost of trouble or money; and a water bailiff, instead of relying on the divine infallibility of his ignorance, should always keep the fish in spirits for examination.

It would not be of any practical value, and would take up too much space, to go into the minute external differences or the distinction between the different kinds of trout. What is wanted for practical purposes are some rules to tell small trout from the young of salmon, and the seven tests I have given are the best I know, but I admit they are very unsatisfactory. But enough has been said to enable, in most cases, the *Salmonidæ* to be distinguished from any other.

The *Cyprinidæ* give much less trouble.

Chub are told at once by their red fins. These are the only fish of that *shape* that have any red on any of their fins; the red on the pectoral fin at once distinguishes them from the only fish they could be confounded with,—the dace, which has no such colour on his fins; while the size of the chub's scales, and the absence of the green back as well as the colour of the fins, distinguish the chub from the bleak. The green back of the bleak and its smaller scales distinguish it from the dace. Another test is that the scales of a bleak, if it is handled, come off at once on your fingers, those of the dace do not.

"The roach is easily distinguished from the dace or the chub by its more oval shape and by its red eye; from the rudd, by the latter usually running a little smaller than the roach. The rudd's dorsal fin is said to be nearer the tail than that of the roach, and its upper lip rigid, while that of the roach is not. The bream is known by the peculiar shape of its body, which is deep, flat, and very convex above and below."

Gudgeon can at once be known by their colour and the two wattles in the mouth. No fish of their size and colour has those wattles; the barbel has wattles, but it has four, two on each side, and his size is larger and his colour is quite different. The loach has wattles, but is smaller and has six; it has not the spots on the side the gudgeon has.

I have not mentioned carp or tench, as they are so rarely found in rivers; but the large scales of the carp will prevent it being mistaken for any other fish, while the small scales and slime of the tench will prevent any donbt as to it. The colour of these fish is different from that of any other fresh-water fish.

These are the chief fresh-water fish that are met with, and with a very little care and a very little trouble any one who cares to do so can at once learn to distinguish them from each other. The only real difficulty of importance is between salmon and trout; as to all others it rarely can become of importance to say what the fish is with absolute accuracy; but with salmon and trout in the present state of the law there is a real practical difficulty. It is, however, only right to add, that in ninety-nine cases out of a hundred, with a little care and a little practice, a person ought to be able to speak of these with as much certainty as he could on the species of any other fish, and to give reasons, for his opinion that should convince any ordinary person except a poaching justice. In the hundredth case there is a difficulty, and it is by far the best thing to admit it.

CHAPTER III

THE LOCALITIES FOR FISH

HAVING stated how fish are to be distinguished in or out of the water, the next point for consideration is the application of those rules, and to state in what places different kinds of fish are to be looked for. These vary with the times of year; but, broadly, the same fish may usually be found in the same places at certain times. A very little attention will give a general idea as to where to look for them. Here, as in everything connected with fish, there are two great principles that determine the matter,—breeding and food. Speaking very broadly as to breeding, there are three general rules to be followed to tell what are the fish seen spawning—first, the time of year. The *Salmonidæ*, other than grayling, breed in autumn or winter, the coarse fish in spring or early summer; so that fish seen spawning in the autumn or winter are *Salmonidæ*, those in the spring or summer, coarse fish.

Next, the place of spawning. Roughly speaking, *Salmonidæ* spawn in gravel, coarse fish do not; this is liable to exception, but it may be taken as a rough test, and fish seen spawning *in*, not *on*, gravel, are usually *Salmonidæ*.

The third general rule is that *Salmonidæ* spawn in pairs; coarse fish may or may not,—some do and some do not.

These rules give a general idea as to spawning fish; an examination of the rules in detail supply a good deal of information.

First, as to the time of year.

It will be best to begin in the autumn, with September.

When the fishing ceases for salmon on the first of September, as it does unless altered by Byelaws under the Salmon Fishery Act, 1873, salmon are, or rather ought to be, beginning to congregate about the mouths of rivers with a view of ascending to spawn. The ova in the fish will have begun to develop, and this development proceeds rapidly. A point on which there is no really reliable information is the rate at which this development takes place. I believe that as long as the fish stay in the estuary, the development is slow; but that when they get into fresh water, it becomes more rapid, probably owing to the change of temperature, and that this development is increased the longer the fish stays in fresh water. This applies not only to females but also to males. There is a slow gradual development of both milt and ova going on, which becomes greatly accelerated when the fish pass into fresh water, provided it has begun before they left the estuary. There are various matters connected with this question that deserve very careful consideration, but which lie outside this book. Here all it is necessary to say is that the migratory *Salmonidæ* congregate at the mouths of rivers at the end of August and the beginning of September, waiting for a rise in the river to ascend: and those who have charge of a river should be careful to watch the fish at the mouth of the river, as they are easily poached; and a fish then poached is a serious loss to the river, reducing the spawning stock by so much. Gradually the fish that assemble about the mouths of our rivers work up singly, if no rise in the river, in shoals, if any freshet; and the prosperity of a river depends on these fish getting up without delay.

The first fish to spawn are generally the migratory trout; it is said they spawn as early as September in some streams, but, if this is so, which is doubtful, it is very exceptional. However, the beds should be most carefully watched from the last week in September, and notes made of all the spawning fish seen on them.

It is difficult to say as an abstract matter where salmon will spawn. Fords with a rough gravel bottom and a clear running stream over them are the places; but in every river there are some fords that appear the very best spawning ground, but upon which salmon never spawn. It is impossible to give any reason for this; but it is found that as the stock of fish increases fish spawn where they had not spawned before.

Every bit of likely water must, therefore, be watched, and notes made, whether fish do or do not spawn on it. If they do, they require watching; if they do not spawn, careful watching may help to find out why they do not.

There is also another reason. It becomes daily more important, by reason of the increasing interference with our rivers, that Fishery Boards and fishery owners should be able to give some specific evidence as to the value and productiveness of their fisheries: this can only be done by having some reliable evidence as to the spawning fish. Therefore, bailiffs should be instructed to make a return each year of the number and places where they have seen any spawning fish.

The first fish to spawn, as has been said, are migratory trout, and from the middle of October until the middle of December they may be seen on the beds. In rivers where salmon are numerous, there seem to be several runs of spawners who spawn at different times throughout the season; in other rivers there appears to be only a single lot of spawners, but whether many or few they will be seen on the beds between Michaelmas and Christmas; and it is only on the beds that they can be seen if there are few in the river, for the regulation mesh of nets, two and a half inches from knot to knot, let large numbers through, and so they are seldom caught.

The size of the spawning fish is generally the best guide as to which are migratory trout; and the rule would be that small fish from 1 to 3 lbs. seen spawning on beds from October to the middle of November are migratory trout.

The next fish in order to spawn are salmon, and the time over which salmon may spawn extends from about the end of October to the end of February. These are the extreme limits; generally, on most of our rivers, the spawning time is limited to December and January. It is a very good test as to the prosperity or otherwise of a river to have an accurate record of the spawning time; the rule is that the earlier the spawning the more prosperous the river, and if the spawning can be got over by Christmas so much the better. The later the spawning season becomes, the worse the river is getting; and those rivers that have only one lot of spawning fish—and that lot in January—are in a bad way. The reasons for this rule are too long to be given at length; but they may be said to be, early spawning fish show a good stock of fish, as they imply numerous runs of spawners; late spawning fish imply a small stock, only one lot.

Between the middle of October and the end of February the fords should be most carefully watched, not only those on which salmon are known to spawn, but also those that are well adapted for salmon spawning. Notes should be made each day if salmon are or are not seen; if they are, when and in what number; and the places, number and size of the fish should be accurately noted. No one can mistake a spawning salmon except that it is possible a large migratory trout might be taken for a small salmon in the early part of the season. But after the first of December all large fish seen on the spawning beds until the end of February are almost certain to be salmon.

Another way of noting the salmon in a river is to watch at the weirs or other obstructions to their passage up the stream; and from the end of September to the end of February the fish will be seen leaping or rushing at these places, trying to get up the river whenever there is a rise of water. The number of fish seen will give some idea as to the size of fish ascending, but it is very fallacious as to quantity. It is fallacious to take a fixed time and count the number of fish seen leaping during that time. In this way some idea can be formed of the size of fish ascending, though but little of their quantity. Often it is said by a watcher, "I stood a quarter of an hour at such and such a weir; I saw so many fish jump." But probably the same fish has been counted at least twice, possibly oftener. Any one watching salmon jumping at a weir cannot fail to notice the same fish again and again. A certain interval takes place between the attempts, but that varies in proportion to the strength of the fish and its condition as to spawning; probably a fish not very far advanced would try again after an interval of five or ten minutes. The fish also try far more at certain times of the day, for instance between 3.30 and dusk. So the test by taking any fixed time and counting the number of fish seen during it is no real guide: it is useful as showing that fish are there and want watching, but it proves nothing more.

It is, however, a matter of great importance to have accurate observations as to the fish seen at weirs; not only to know the number of fish, but also to see what part of the weir they usually attempt to get over, and in what states of the water. It is impossible to construct a satisfactory fish pass without knowing the part of the weir the fish mainly frequent, and whether they go there only at certain states of the water or in all states. This cannot be too closely observed.

The salmon spawning is usually over by the middle of January; it may be prolonged into February, but that is rare. When the spawning is over, the kelt difficulty arises, which will be dealt with later. It is important to know where the salmon spawn for two reasons: (1) to see what parts have to be specially protected, for the rule usually holds good that where a salmon has once spawned he continues to spawn; and (2) to see if anything can be done to enlarge the spawning area, for it often happens that from one cause or another the same ground is gone over by different sets of salmon during the same spawning season and the ova already deposited are routed out and lost by the new comers, so that only a small percentage of all the ova deposited is hatched out.

If migratory trout or salmon on running up a river are unable to get higher, and are not ready to spawn, they lie in the deep pools until either a freshet comes, when they try to go on up, or until they are ready to spawn, when they begin spawning on the nearest shoals. Here the fish want careful watching, for they are usually easily gaffed just before spawning, and they are liable to run up with the first water into unsuitable places to spawn,—places where the beds will be left dry before the ova can be hatched out. Indeed it may be said with truth that from the time the salmon begin to ascend in September till the time they go down as kelts in March or April, they are or should be a source of perpetual worry to the water bailiffs and conservators. No river can prosper unless the fish during this time are carefully looked after, and during this time as a rule Fishery Boards do not look after them, or, if they do, not sufficiently.

Both migratory trout and salmon, having spawned, drop back from the shallows to the deep water, and there remain to recover, or, rather, to stay in the shelter until a freshet comes, when they descend to the sea. It is probable that solitary fish do not wait for a freshet, but drop down day by day until they reach the tideway. It is also certain that some remain till late in the spring, feeding on the fish in the pools; but the majority go down the first or second freshet after they have spawned. They probably do not go the whole way to the estuary on one freshet, but gradually drop down. This is shown by the netting in the early part of the season. In the fresh water, high up, generally a number of kelts are taken at a draught. Lower down the take is fewer, until just above the tideway one or two only are caught. The information on this subject is most meagre, as there is, or rather ought to be, little netting in close time. When there used to be fixed engines in use in the Severn in the early part of the season, large numbers of kelts were caught after a freshet, at other times only one now and again. So the rule would seem to be as above stated. This is so as to healthy fish; but as to unhealthy fish, and there are always a certain number of diseased kelts every year in each river, if they are badly diseased they will get into backwaters or even ditches after a flood, and it is no uncommon thing to hear in January or February that in a pool or ditch communicating with the river there is a large fish. At first the idea is that it is a pike, but it is as likely as not to be a kelt. It is, doubtless, illegal, but the best thing to do with these fish is at once to get them out and kill them; they will never do any good to the river; they will probably get worse and die, and the sooner they are killed and buried the better. One caution should be given as to burying diseased kelts. Do not bury them close to the river, and bury them fairly deep. If they are close to the river it is by no means clear that worms and insects do not convey some of the microbes to the river. If they are not buried deep enough, dogs and birds will get portions of them up, and most likely some part will get back to the river and become a source of future contamination.

All through the spring months, say to the end of April, in any river in which there is a fair stock of salmon, kelts may be seen about. After February they will generally take almost any bait, fly or minnow, in the pools in which they are lying; they do not give very much sport as a rule, and their whole conduct differs from that of a clean salmon. But when there is nothing better to be had, kelt fishing on a spring day is not to be despised.

Kelts may also be seen, when the water is clear, dropping down the river at weirs and mills, and lying about in mill pools. They may at first sight be taken for pike; but any one who has seen a pike could not mistake it for any other fish in or out of the water. Kelts also usually lie deeper in the water than pike do, and almost invariably with their heads *up* stream. They are not infrequently seen going over weirs in their descent seaward, if there is enough water to cover them. One of the great rules in salmon preservation is, get the kelts out of the river as quickly as possible; and notes should always be made if any are seen lying about in the pools, so that arrangements may be made to get the nearest sluice pulled up and the kelts sent on their way seaward although as the law now stands this is illegal.

The non-migratory trout spawn from about the end of October to Christmas, and in the brooks and rivers they will be seen on the redds in the same way as salmon. The time when they spawn is regulated to a great extent by the condition of the stream and the weather. Thus, in a stream with a high temperature trout always spawn sooner than in a stream with a low; and the conditions of the atmosphere also affect the time of spawning. But between the dates mentioned trout usually spawn; and careful observation should be kept on each stream to note the earliest and latest date when they are on the redds. There cannot be as a rule any great difficulty in speaking positively as to spawning trout, for there is no fish at that time of year of their size that are seen in such places. Grayling might on a fine day be seen on the fords in the autumn, but not spawning; and a person who pays any attention to fish will very soon be able to distinguish spawning fish working in the gravel from feeding fish, not but what fish that are spawning feed when doing so. As soon as trout have spawned they drop back into the pools and remain there until they have recovered. This period again varies in different streams, and depends mainly on the food in the streams, and the kinds of food; if the food is mainly flies they take some time to recover; if it is mainly worms and water-snails they recover much more quickly. The trout remain in the pools until February or March, and on the first warm days come up on the shallows to see if there is any fly about or food to be had. But in those streams where there is plenty of bottom food the trout do not come on to the shallows so early in the spring as they do where there is little,—they are not so hungry.

One rule should be mentioned as to autumn-spawning *Salmonidæ*, which, although not invariable, forms a fairly safe guide as to what are the species of fish seen spawning,—namely, the size of the gravel at the places where the fish are seen. Trout like fairly fine gravel, migratory trout rougher, salmon roughest of all; and if the size of the fish is not a conclusive test, a very good idea can be gained from the character of the bed at the place where the fish are observed spawning.

I never saw any char on a spawning bed, and can give no data how to distinguish them derived from my own observation; but the usually accepted statement is, that they spawn on the shoals in lakes in the autumn. As trout usually leave lakes and run up the streams that flow into them to spawn, if fish are observed spawning on shallows in lakes in which char are found, it is probable that these spawning fish are char; but so little is known of char or their habits, and they are found in so few places, that it is of no great importance to the ordinary persons engaged in fish preservation.

The same remark applies to the *Coregoni*. I know nothing, and I never met any one who could tell me anything, definite as to their habits. It is true that one form, *C. clupeiodes*, the guiniad, is found in Bala Lake; but all I have ever been able to find out about them is, that after a severe winter, if there is a storm, they are sometimes washed up dead, and when this happens, they are usually preserved as curiosities. Grayling are different;—here we are on well-known ground. They spawn in April, and they are chiefly remarkable for this, that their spawning time is the shortest of any of the *Salmonidæ*. If in a running stream any fish are seen spawning on the gravel in April, it may be said with certainty they are grayling. About the beginning of the year the larger grayling drop back into the pools and remain there until the middle of April, when they come on the shallows to spawn. They could not be mistaken for any other fish, for all the other *Salmonidæ* have finished spawning before this, and the coarse fish which may have begun to spawn do not spawn in pairs as grayling do. When grayling have spawned, they drop back into the pools, where they remain until they have recovered condition—generally not before the end of the summer or the beginning of the autumn, though (as in the case of trout) the time varies and depends on the river and the food.

The first of the coarse fish to breed are pike; and if it is desired to get rid of them, there is no time like the breeding season, for the pike then run up backwaters and ditches, and are easily snared by an expert. Netting for pike is always an operation the success of which is doubtful; but in February and March with the snare or the gun or even a gaff or spear much may be done to keep down pike. Something may be done with a net. It is the best chance there is to destroy them, as they have got into places fitted for their destruction. Where it is desirable to kill down pike, all the ditches and backwaters should be carefully examined on a fine day in February or March. There will then be no difficulty in seeing the pike. As soon as they have spawned, they drop back into the river; and very soon recover, probably on account of the quantity they eat. After April a pike out of condition is a rare fish. No other large fish are to be seen in ditches and backwaters in the early spring, unless it is an occasional old kelt. So if a large fish is reported to have been seen in such places, it is fairly certain to be a pike; and the best thing is to take steps at once to get him out by snaring, gaffing, shooting or any other device. Pike seem to remain in the ditches and backwaters until there is a rise in the water, and then at once to return to the river. They seem also to come up from the river in a winter flood or high water. Pike are then always on the move, and those who know how to use that most poaching of all fresh-water nets—a cleaching net—will best appreciate the way that pike in the winter floods make for the ditches. If the opportunity of killing down the pike in the winter and spring is neglected, there is but little chance of doing it during the rest of the year, as once they have recovered from spawning and returned to their old haunts, it takes a very expert fisherman to catch them with a net, and in nine cases out of ten he only does it by accident.

At the end of February the *Salmonidæ*, except grayling, have spawned, and the coarse fish spawning time is coming on. Dace collect in shoals in the winter and early spring and continue in the deep water till the weather gets warm. If it is desired to kill them down, the time to do it is by systematic netting in January, February and March, as then, being together in large shoals, they can be caught in quantities. To a lesser extent this also applies to chub and roach, but it is mainly true as to dace. If then it is determined to reduce the coarse fish in a river, attempts should be made to do it in the spring; but the netting should be done with a net, such as a bush net or a trammel, that does not in any way disturb the bed of the river, or the shoals on which the salmon have spawned; a draught net should not be used anywhere near the fords until after the salmon ova have hatched out.

The warm days, if any, at the end of March or the beginning of April find the dace spawning; they spawn in shoals; the water often looks alive with dace which are all either spawning or about to spawn. A pool of moderate depth, with a quiet stream passing through it, is the place selected; the spawning lasts about a fortnight or three weeks. During the time of spawning dace are very easily poached, any number can be taken in a casting net, and often some may be caught by snatching. In any case it is important to keep a strict watch on them, for if it is desired to destroy the dace, then is the time; if it is desired to preserve them, then watching is necessary to prevent them being poached. As dace are one of the first fish to spawn, so they are one of the first to hatch out. In May, in the backwaters and in any quiet place, the fry may be seen in thousands. Their enemies are legion, but their numbers are myriads; and even with the enormous loss there is of fry, a large number, far too large in many cases, pass into the stage of yearlings.

The next fish to spawn in point of time are grayling; they spawn towards the latter part of April, and no fish get their spawning done quicker; consequently no eggs are more difficult to get for artificial breeding than those of grayling—one is always just too early or too late. The grayling are said to spawn without making any redds like the other *Salmonidæ*. This, however, seems doubtful; the redds are much less than those of the other *Salmonidæ*, but I believe that there is a redd of all *Salmonidæ*, or something like it, in all cases. The eggs hatch out in from fifteen to twenty days. The spawning fish drop back into the deep pools after spawning, and take longer in recovering than most of the *Salmonidæ.*

At the end of April and May the roach and chub begin to get ready to spawn. It is one of the habits of these fish to push up the river before spawning. How far they will go is not clear, but at any weir or obstruction they will work up exactly in the same way as salmon, and will similarly jump out of the water at the obstruction. I never realised the extent to which the roach and chub pushed up a river until one year at the end of April. As some damage had been done to a salmon ladder I had it stopped and the water in it run off. All the pools that formed the ladder were literally alive with roach and chub, there were but few dace, but the roach were in shoals. Since then I have noticed that every year the coarse fish push up stream before spawning; and it is their habit of pressing up to higher water, aided by the salmon ladders, that has in many cases enabled them to drive the trout from waters where trout were formerly abundant.

Chub spawn on shallows at the end of May and sometimes in June. As they will take a bait before, during, and after spawning, and as no one ever eats them, it is difficult to say how long it takes them to get round after spawning. But by the middle of July the spawning of all exclusively fresh water fish is generally over, and these are to be found in the pools or on the fords scattered about the river. The habit of congregating in shoals seems only to prevail just before spawning. That there are fish in shoals afterwards is quite true, but the size of the shoals in the summer and autumn is not in any way to be compared with the size of them in winter and the early spring.

In June eels begin to descend the rivers to spawn in the sea and continue descending until the end of October or November, a proceeding which necessitates keeping a watch on the traps and nets placed to catch the descending eels.

In July and August there is little or no spawning, and the fish are scattered about looking for food —a change in habit which necessitates a change in the mode of preservation: during spawning time attention had to be fixed on certain spots, afterwards attention has to be given to the whole water.

There are, however, always places where fish congregate: a pool under a mill, a pool under a weir, a pool where two streams meet; a number of such places will recur to every one's mind. If these places are observed, it will be found that the fish resort to them because they are good feeding spots. It may not be apparent at first, and it may want a good deal of thinking out and observation to discover; but it is almost certain that a favourite pool for fish means that for some reason or other it is a place where there are special means of feeding. For instance, I knew a pool that on one side was always full of coarse fish—on the opposite side were very few. It was quite obvious there was some reason, but no one could say what it was, until one day, when an old drain was taken up from a farm yard, it was found to discharge on the favourite side, and to be full of brandlings.

The old rule, "once a chub hole always a chub hole," is only another way of stating the same fact; the hole is a place where from the set of the stream or some other reason a large quantity of floating food always passes; but if the food supply be cut off, the hole ceases to be attractive. Who does not know cases of fish practically deserting a hole because a tree is cut down and so the food supply stopped?

In one way or another a man by watching can pretty well locate the fish in a river ; he will know the feeding and the breeding localities, and he will be able to say where the fish are to be found at the different times of the year ; and that will mean what places are to be watched and when.

This knowledge is useful in another way. In every river there are a number of fish, usually large ones, who, for some reason or another, have ceased to consort with their fellows and prefer to live alone. A ford will have one or two large trout always on it—a pool will have a large chub, who basks at the top of it—a pike will daily take up his position opposite a patch of weeds. These are the fish that ought to be killed, and the sooner they are out of the river the better. They probably are barren fish and will never breed, and all they do is to consume food to no purpose. If caught and examined they will usually be found to be males ; and as with game so with fish—there is no sounder rule than to kill off the old cocks. On a moor I once had, I used to make a practice of killing every solitary grouse I could up to the middle of March, and people used to ask what I had done to so improve my shooting. In a river, if all the old trout who usually turn cannibals and who have ceased to breed are killed down, it is quite wonderful how the stock of fish improves. A knowledge of the haunts of fish should also give the knowledge of the fish that should be killed each year. I am quite aware it is said to be most unsportsmanlike and illegal; but if I were getting up a stock of trout in a river, every year all solitary old males, and a certain number of old females when they had reached a certain age should be killed down by any and every means, without pity or remorse.

Knowledge, the more accurate and detailed the better, of the haunts of fish in a river is therefore wanted:—

First, to enable the watching to be carried on to the best advantage, and the watchers to be placed where the fish are, and where they are likely to be poached. Not to watch fords if the fish are in the pools, or the pools if the fish are elsewhere.

Next, to be able to ascertain what the stock of fish in the river is, and to take steps either to reduce or to increase it in the most effectual way.

And, lastly, to be able to say what fish ought to be killed down and what to be kept.

The application of these rules will, of course, differ with the extent of the fishery and with its nature and with the fish it is desired to encourage or discourage; but until this knowledge in a more or less perfect state is acquired, it is quite impossible to determine on what principle the river is to be preserved, or how the preservation is to be carried out. It need hardly be said that, if a man really wants to preserve his river, he must acquire this knowledge, as far as possible, himself, and not trust to others. There are also some things which require to be done, and if done, as they are illegal, he had far better do himself, and say nothing about them, than entrust a breach of the law to others. It will soon be seen in fishery management that a large number of the provisions of statutes and byelaws are passed and framed on the principle of how not to do it, and that a rigid adherence to the letter of the law is often the worst possible way of managing a fishery.

CHAPTER IV

STOCK OF FISH

NOT the least difficult problem in fishery management is to determine the proper quantity of fish a river, or part of a river, will carry; it involves so many considerations upon most of which there is very little, if any, reliable information, that to a great extent it is labour in the dark. The difficulty is greatly increased in a stream in which migratory *Salmonidæ* are found, for it is quite possible they may entirely upset all previous calculations. But it is very necessary to get some idea, first, as to what the stock actually is; and, secondly, what stock the river will carry, so that steps may be taken to keep the stock in a proper state either by decreasing or increasing the numbers. If there are several sorts of fish in a stream the matter is still further complicated by the question, which kinds are to be encouraged? Altogether it is one of the most difficult of fishery questions. Some general rules can, however, be laid down, which, if they will not give all the necessary information, will at least put those interested upon the right track to seek for more detailed knowledge.

To take the simplest case first,—that of a trout stream in which trout are the only fish, or the only fish that need be noticed, for in most trout streams some other fish, such as minnows, loach, and eels may be found. If the stream is over stocked, it will show itself in two ways,—deficiency of spawning ground and deficiency of food. As to the first, this will be seen (1) by the number of fish on the redds at the same time in the autumn; or if the redds are day after day worked over by fish, and numbers of fish are seen trying to spawn, not merely numbers of males after one female, but numbers of females coming to the same redd, and first one spawning a little and then another; or if the redds are persistently made in unsuitable places, —that is in places where if there were more available ground the fish would not think of spawning,—then the inference is clear that the fish at that particular place are too numerous. (2) If the trout spawning time is spread over a long period, say, into January, and has been going on continuously since the end of October, then again it is an indication that there are too many fish. (3) If, again, fish full of ova or milt are found dead in any numbers and without any apparent cause, the fish being healthy, except signs of inflammation, this again shows that the river is too crowded with fish. I should say, however, that it is only twice, and on both occasions on small trout streams, that I have met with this. (4) There is another sign which seldom occurs, but does sometimes in a small stream. It may happen that a river while the fish are on the redd falls very low; for instance, the water may have been drawn off for a mill, with the result that the channel below the mill weir is left dry or nearly so. If a close examination shows that below the redds there are to be found in any number traces of loose ova, this again would go to prove an over-stock.

It should, however, be borne in mind, that the over stocking would apply not necessarily to the whole stream but only to the particular locality, and means should be taken to relieve the congestion. Fish have a habit, trout especially, of spawning in certain places and leaving ground that is well adapted for spawning without a redd on it. One of the things that can be done with advantage is to distribute the spawning fish by netting them out and placing them on other parts of the river, or its tributaries, or spawning them and hatching out the ova artificially. It is, however, an operation that requires a considerable amount both of knowledge and judgment to make it successful. It may end in only killing the fish or injuring them so as to waste their spawn, and cause a bad spawning season.

¶ Food, or rather the condition of the food supply, is a better test as to whether or not a river is over stocked. (1) The great point is to note when trout are in condition—how early in the year. The question of condition is a question of food. After spawning, the fish want feeding up to recover, and the time taken in recovering depends to a large extent on the food the fish get; if plenty, they recover soon; if barely enough, it takes some time. Although there may be other factors to be taken into account, yet, as a broad rule, if the trout are in condition and fit to be taken on the first of March, the river is not suffering from over stocking. (2) The next point is, how long do the fish keep in condition? If they do so fairly well through the season, if even late in the year the barren fish are in condition, and only those which are breeding fall off, it may be inferred that the fish are not too numerous, that there is plenty of food, and the river is not over stocked. (3) But the surest sign is the size of the fish. If the river is over stocked so that there are too many mouths for the food, it will show itself in the size of the fish. An over stocked river has usually fish of only two sizes, large and small; fish of two or three pounds, old cannibals who live on fish, and who are the most destructive creatures there can be in the river, and fish which cannot get food enough to grow beyond a certain size, say five or six to the pound. If the river is not over stocked, that is, if the proper relation between fish and food is kept up, fish of all sizes should be met with, small, medium, and large ones. Other points might be mentioned; but, if a river has healthy fish of various sizes, in good condition, the majority being neither one size nor another, the presumption is that it is not over stocked. This rule applies both to non-migratory *Salmonidæ* and coarse fish, as the cause produces the same result in both. If there are fish of various sizes, it may well be that it is under stocked, but it is certain that the treatment it requires is not depletion. Of streams that contain nothing but trout, and which are over stocked, the number is very small. It chiefly happens in those cases, where there is a considerable natural stock, but, not content with that, the owner annually turns down large quantities of fish. Fortunately, the number of persons who can do this on a large scale is limited; and it does not seem likely that at present our trout streams will suffer from over stocking. Some of them might, however, be greatly improved by netting out the large old fish, and, possibly, some of the small ones; as there can be no doubt that in some of our streams a diminution of numbers, especially of the larger fish, would cause a better average size all round.

As regards salmon and migratory trout, it may, at the present time, be said to be a rule without an exception that no English river is fully stocked with salmon. It may be that in some rivers if the stock of migratory trout were reduced, there would be more salmon; that the proportion which they bear to the salmon is too large, and that they are gradually overcoming the salmon, as the coarse fish are in other rivers crowding out the trout; but there is no English or Welsh river, in which there are no migratory trout, that is anything like fully stocked with salmon, and there is no English or Welsh migratory trout river that is fully stocked with migratory trout. It is quite true that in many of these rivers there are certain places where salmon and migratory trout spawn, usually places below some obstruction, that at spawning times are over stocked, where it is one part of the duty of fishery authorities to see that the fish are not suffered to congregate, but are distributed over the whole river; but this is only a local matter, and applies to one or two places not to the river as a whole. All our English and Welsh salmon rivers should carry at least five or six times their present stock of fish. It, perhaps, should be added, although it is an unpalatable truth, and is kept in the background as much as possible, that the stock of salmon in all our English and Welsh rivers is decreasing, and, in some cases, decreasing with an alarming rapidity.

What has been said about salmon and migratory trout applies also to trout and grayling. In some rivers into which grayling have been introduced with the object of getting fishing all the year round, and of introducing sporting fish, the grayling have interfered, and are interfering seriously, with the trout. If equal quantities of trout and grayling were placed in the same stream, the result in a few years would be that the trout would have largely decreased, and the grayling increased; for the trout, if he is to live and thrive, requires some protection against the grayling. It is difficult to lay down any general rule as to the proper proportion to be maintained between the two fish, as so much depends on local circumstances,—the nature of the river, the supply of food; but it may be, as a rough guide, stated that if the trout are to prosper, the grayling must be netted down, and a proportion of something like half as many trout again as grayling kept in the river. This is just one of those points that local Fishery Boards were formed to ascertain, and which they have wholly failed to do.

With *Salmonidæ*, the task of dealing with the stock of fish in a river is very difficult, though not impossible; but when the coarse fish question comes in, the difficulties are increased beyond measure. By applying the rules already given as to trout, you find the river has too many fish, and the stock requires to be reduced; the question then arises, what fish are to be sacrificed; and the person who can answer the question fairly, and give reasons for his answer, possesses a knowledge of the river of a very high order. A very little practice will enable one to say whether there is too large a stock; but it wants a great deal of practice to say how the reduction is to be made. Most Fishery Boards and fishery owners have their own way of solving this difficulty: they think that to turn in so many thousand fry will do all that is required; fortunately, in most cases, the fry die, or are eaten, and no other result follows than the waste of money.

It would be wearisome, even if it were worth while, to go into the case of each of the fresh-water fish, and set out the reasons for and against—decreasing the number of fish in a stream. For practical purposes one or two broad rules will be sufficient, and if these are acted upon, a fairly judicious reduction may be made.

(1) The first rule is to consider the power of increase of the different kinds of fish, and probably three will stand out conspicuously in this respect—chub, dace and roach. It is true the test that is about to be applied is not more than an approximate one; but it will be sufficient for the purpose. What amount of spawn does each of

the fish carry to the pound? Having ascertained this, the productive power can be considered in the light of the number of eggs.

It therefore follows that if it is desired to decrease the stock of fish—every thing else being equal—the fish that breed the most rapidly should be the fish first dealt with; these are, chub, roach and dace. If an equal number of trout and chub are placed in a stream, the chub will obtain the upper hand, as the chub produces more ova than the trout. That this is so is shown by the like case of trout and grayling. The Kennet at Newbury was a trout stream, pure and simple. Grayling were introduced, with the result that the grayling have so far obtained such an ascendency over the trout, that their numbers have to be kept down by netting. It would be the same with the chub. The reason is not far to seek: not only is the number of ova greater in the coarse fish, but it is a rule that all fish that spawn in the spring and summer produce more fry than fish that spawn in the autumn. One reason is that autumn-spawning fish spawn in unsuitable places in high water, which, when the river drops are left dry and the ova perish; but spring-spawning fish spawn in low-water time, and their ova are placed where they are not liable to be left dry; so that this danger—and it is a very real and increasing one now that the height of the rivers varies so much more than it used to do—is lessened in the case of coarse fish, and increased in the case of trout. This is one of the reasons why, other things being equal, the grayling gets an ascendency over the trout. Another way of stating it is that of the ova deposited the percentage hatched out in spring-spawning fish is considerably greater than in autumn-spawning fish. When this is added to the fact that the quantity of ova produced by the spring-spawning fish exceeeds that produced by the autumn-spawning fish it follows that it is a mere question how long the autumn-spawning fish can hold out without artificial aid. Nor does the matter rest here. In autumn there is little food for fish, and that little entirely underwater food; in spring there is a good deal of surface food. The feeding fish in the autumn are feeding on the bottom, and so take a far larger proportion of the ova than they do in the spring, for this reason, that in autumn this is the only source of food, in spring it is one of the many sources.

Leaving out therefore everything else, the natural conditions are against the *Salmonidæ*, and the unfavourableness of the conditions has been increased so far as regards the *Salmonidæ* by the requirements of modern life. The alteration in the height of the rivers in winter tells strongly against the *Salmonidæ*, but does not affect the coarse fish. If the trout are to be maintained some means must be taken to reduce the balance against them. But if the position of the trout would be untenable against the chub alone, it is made far worse when to the chub is added the dace, and to the dace the roach, to the roach the ruffe, to the ruffe the bream and all the other kinds of coarse fish. It only requires to be looked at from this point of view to show how impossible it is for the trout to hold his own against all this host of enemies.

Before the late Mr. Mundella tried his hand at fishery legislation, the difficulty was not so felt, and for this reason, that every year a certain quantity of coarse fish were killed down, there being no close time. The natural advantages enjoyed by the coarse fish enabled them to hold their own, and more than their own, against the *Salmonidæ*; to-day, after twenty year's protection, the coarse fish far outnumber the trout. Every year the state of things is becoming worse and worse. The Fresh-water Fisheries' Acts are a very striking instance of the evil that is done by well-meant attempts by benevolent gentlemen interfering with the natural order of things, without considering what will be the effect of their interference. If, therefore, it can be shown that under present circumstances the most valuable class of fish is liable to be exterminated by the less valuable, it follows that some steps must be taken to restore the old state of things and enable the valuable class to hold its own. It is not a question of rich or poor, of the gentleman's sport against the labourer's, or any nonsense of that sort. It is a mere question of fishery management. A fish of a valuable kind, which will pay better both to sell and to catch, will do well in a particular stream. He is in danger of being exterminated by fish which will not pay to catch or to sell. Should steps be taken to preserve him? If in farming it were found that a crop paid when all the weeds that prevented it getting to its best were got rid of, the farmer who neglected to get rid of the weeds would be called a fool. The same principle applies in fishery management, only here the Legislature does its best to help the weeds to kill down the crop.

Assuming it is determined to keep up the stock of trout, or rather that Fishery Boards do their duty and keep down fish that are injurious to *Salmonidæ*, the next question is, how to set about it? Here local preference comes in. Which kinds of coarse fish are to be kept? Are they all to be kept down, or will it suffice to keep down certain kinds? This to a great extent depends on the local feeling, and no rule can be given; but it may be said at once, that the most injurious and least useful kinds should be kept under. Here the rule is, that those that feed exclusively on the bottom are more injurious than those which combine bottom and surface feeding, as bottom feeders take more spawn, fry, and small fish. A pike is a most mischievous fish in a river, but it is by no means clear that he is the most mischievous. It is doubtful if he is worse than an old cannibal trout who has left off surface food and devotes himself to more satisfying and *recherché* forms of diet. But a pike has a bad name and a worse appearance, and is looked on as the incarnation of evil. Probably the worst enemies to fry are eels; but they are impartial enemies, and keep down both *Salmonidæ* and coarse fish with an omnivorous appetite. Gudgeon and ruffe are both exclusively bottom feeders, and do considerable harm. Something may be said for the gudgeon. He is good to eat, and gudgeon fishing is the ideal of "the contemplative man's recreation"; but for the ruffe all that can be said is "get him out of the water as quickly as possible." Roach are also fish that may be kept down with advantage. Perch are, it would seem, from some cause, decreasing, both in numbers and in size. Dace feed so much on the surface that they may be regarded with bleak as the most harmless of the coarse fish. Chub, particularly large chub, are most destructive for two reasons; first, their appetite is large, and secondly, they are practically omnivorous, and while they take surface food it is only to excite their appetite for other kinds. A large chub will stow away a considerable number of small fish. If any one doubts this let him open as many chub over one pound as he can, and note the contents of their stomachs. But in favour of the chub must be said that his liking for young fish is not confined to *Salmonidæ*; all young fish he takes equally. It is just one of those points on which it is most dangerous to give any opinion,—what coarse fish should be killed out, and what should be preserved; for no one can venture to foretell the effect of increasing particular kinds at the expense of others. It may well happen that if one species be reduced too low, a new and worse state of things will arise. The safe rule is, that it is not well to interfere with the natural balance of power, and that as we want to preserve the natural state of things, we should keep down the spring-spawning fish as a whole, not any one kind of them in particular. If netting were practised every year, so as to take out a certain quantity of coarse fish, a quantity which would depend on the number in the river, and on the number of trout, probably a few years' experience would show what number ought to be the average to be taken out and what should be the minimum. So far the results have been that the coarse fish have, in trout streams where there has been any netting of them at all, been taken out with a view to their extermination, not to their regulation. This is the right course if a stream, or the reach of a stream, is to be used as a trout preserve and nothing else: but if the last legal view is right, that it is illegal to shut out fish from a part of the stream, and that every riparian owner can compel the stream to be kept open, then it becomes a question of regulation, not of extermination. The rule should be, take out a certain quantity of coarse fish every year, the exact quantity being dependant on local circumstances, and what it is desired to accomplish.[1]

Two other points require consideration. Is there any alteration in the river below, such as weirs or obstructions, making the river more favourable for coarse fish, and less favourable for *Salmonidæ*? It may be taken as a rule that all modern alterations to a river, such as improving the navigation, abstracting water for waterworks, tend to favour the coarse fish by making the river more like a pool, of an uniform depth, and doing away with shoals and breeding grounds for the trout and salmon; or, if not doing away with them, lessening their number. It is therefore imperative that, as more coarse fish are bred, a larger number should be taken out. The next point is one which is never considered. Rivers are nominally opened up for salmon. A dam which kept back all fish, trout, salmon, and coarse fish, has a fish pass put into it. Before, the river above the dam was only a trout stream. When the pass is put in, the salmon may or may not come up, usually they do not; but a result that was never intended follows,—the coarse fish do. So water that was really good trout fishing becomes invaded and spoiled quite unintentionally by the action of Fishery Boards. I could point out a number of streams on which the owners have spoilt the trout fishing by trying to get salmon which never will come, but have spent their money most successfully in getting coarse fish. Here, again, the quantity of coarse fish to be taken out depends on whether they are to be allowed at all.

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[1] For a statement as to the case of trout and coarse fish see Appendix II.

Another phase of this question is, where a river is given up wholly to coarse fish: even here steps should be taken, if the best is to be made out of the river, to regulate the stock of fish. A river will only carry a certain quantity, and when that quantity is exceeded, it suffers, usually by the production of a large number of small fish who are starved and cannot grow. As a farmer gets rid of a portion of his old stock every year to make way for his young stock, so should the fishery manager; and the part to be got rid of are the old fish who have ceased to be productive—do nothing but eat; will not take a bait. I once heard an old farmer say, at an agricultural dinner, he was the only man in the county who had four-year-old mutton on his farm; and he was very angry on being told that he did not look such a fool as to have it. So

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with trout or coarse fish. A fishery manager who has these old fish is a ——well, not fit to manage a fishery. In hardly any fishery does the owner or the tenant know if he has any four-year-old fish, but where he does, like the farmer, he boasts of them.

So far what has been said relates solely to keeping down the too rapid increase of certain kinds of fish,—the reduction. But there is the other side of the question,—the increase of stock by artificial means. Artificial breeding has become so popular, and turning down fish so common, that most persons think it comprises the whole question of the management of fisheries. As a rule it is a waste of money; if persons like to do it, they may just as well waste it in that way as in any other. But one or two points have to be considered.

The first is, that although legislation on fishery management is to be deprecated until the knowledge of those interested in it has proceeded further than at present, on one point it is most desirable there should be a legal prohibition, namely, the right that any one has to turn into a stream what fish he pleases. Probably, as the law stands now, if damage could be proved, the person who turned in the fish that caused the damage would be liable, but such damage would be most difficult to prove legally, and unless it could be proved, there would be no remedy. It is not right that the owner of a field adjoining a trout stream should be able to put into it fish that would depreciate the stream. For instance, with the best intentions a man might put grayling into trout streams and seriously interfere with the trout; or he might put in a particular kind of trout that are bad risers. There is no security when an individual, without much knowledge, tries his hand, that he may not do far more harm than good. In a stream where there is a strain of fish which rise well to the fly, the introduction of a strain of fish which do not would be an interesting but a dangerous experiment, and one that no individual should be allowed to make, as he can now. An angling club buy yearlings and turn them down; they do not know, beyond what they are told, what the yearlings are; they may be all right, or they may not,—ova are sold very cheap in Germany, and the yearlings may come from there, and be a form of trout that is not the best adapted for English streams. It is not necessary to refer to black bass or other fish of that nature, which it was proposed to introduce into our rivers. No one should be allowed to increase the evils the fishery managers have to fight against; there are quite enough as it is.

Assuming, however, that the fish to be turned out are all right, how far is it well to increase the stock in this way? No general answer can be given, as it depends wholly on the river. If the stock is very low and there is no cause but over-fishing for its being so, then turning down may be resorted to with advantage to bring up the stock, or to keep it up to its proper level; but if the depletion is owing to any other cause, it is waste of money to try turning down until the cause is removed. If it is exhausted food supply, pollution, changed circumstances of the river, it is then not only merely throwing money away, it is worse; for it often intensifies the existing evil. If the food is not enough for the stock, it is useless to add more mouths to feed. If the fish are being killed down by pollution, it is idle to add to the number till the evil is stopped.

It is also no use turning down a number of fish and doing nothing more. As a rule it is only giving a rather costly *bonne bouche* to the fish in the river; fish turned down are always at first a little sickly, and the sickly fish are the delight of the cannibals in the water. Turning down is probably doing harm, as the fish are usually turned out when there is not much food; it is tempting and inducing fish to turn cannibals, putting all this food before them. I once saw a very striking instance of this. Some chub had been caught and were kept alive in a basin of a fountain; they got a little, not much, food. One of the inmates of the house had been fishing, and turned into the basin the minnows he had not used. At first the chub took no notice, then they went up and looked at them; after a time one chub took a minnow, then he took another. The other chub thought this unfair, and they went for the minnows, who were soon polished off. I could not get the people to try the experiment I wanted, whether the chub would after this eat their usual food.

Stocking has done wonders in places where there are no fish, or very few; but where there are a number of coarse fish, and it is desired to introduce trout, turning down trout without first getting rid of or getting under the coarse fish, has not been productive of useful results.

If stocking is used for supplying the place of a certain quantity of fish taken out every year, and is conducted on some principle such as taking out 500 old trout and putting in 1000 yearlings, then it is intelligible, and will and often does lead to very good results. But if it is done in the haphazard way of turning in so many thousand fry one year, taking nothing out, doing nothing for a year or two, then turning in more fry or more yearlings, it is only a waste of money.

These rules are clear :

1. The autumn-spawning fish cannot hold their own against the spring-spawners without help, especially since the protection of coarse fish.

2. The help should consist in reducing the number of spring-spawners, and probably the best way will be to reduce the fish as a whole, not to try to reduce particular species.

3. The reduction should be by netting out the spring-spawners in the winter, and by killing down fish that are too old to breed and will not take a bait.

4. It is no good trying to add to the stock unless it is clear that it is below the proper number the river will carry,—a point that can be roughly ascertained by the size of the fish ; if they are only very large and very small, the river is over stocked ; if the fish are of all sizes, it is not.

5. If the river is under stocked, unless the want of fish is clearly from over fishing, the cause should

be ascertained before attempting to add to the stock.

6. Turning down fish does no real good, if it is done merely casually and without method; the fish turned down should bear some proportion to those taken out—that is, a part of the stock should be renewed every year.

7. In renewing the stock care should be taken to keep to the proper proportion, bearing in mind that it is always better to under stock than to over stock a river.

There are a number of other considerations on the subject of stocking—only the most elementary rules have been mentioned, and nothing has been said as to migratory *Salmonidæ*, or to the strains of trout it is best to use. All these are matters that require too much detail for an elementary book like the present. Before saying what is to be done, it is as well to see if it is wise to do it at all; and most probably the principles here stated will be far from meeting with general acceptance.

There is another point also deserving much notice: what are the best ways of keeping down fish—what are the best modes of netting and getting rid of coarse fish? Here local considerations come in. What will do for one place will not do for another; what is legal in one is not legal in another. If the views put forward as to the proper management of fisheries find any acceptance, it will only be a matter of detail to state the means for carrying them out. The great thing is to get the principle admitted, that fisheries should be managed on a definite system, the first step towards which is to try to regulate and improve the stock of fish in the water. Whether it be salmon, trout or coarse fish, it is well to produce the best either for food, or for sport, or for both, that the river is capable of, which is just what is not being done. Our fisheries are at present in the condition of a derelict estate.

CHAPTER V

THE FOOD OF FISH

NO question is more important, and none, until lately, has been more neglected, than that of the food supply of fish. It has been assumed that fish will live upon anything, and the question of what is best for them to live upon has been entirely lost sight of; indeed, there are not wanting a number of persons who hold the opinion that fish do not require food. They point triumphantly to the fact that fish will live long in confinement without food, as gold fish in a bowl, or fish in a well-boat, and say, "Why need we trouble about food? they do not require any." That fish will go for some time without food is clear; and although we have no reliable evidence as to how long, it may be granted that it will be for a very considerable time. But so did Welsh fasting girls and other professional abstainers; but they at last came to a bad end, and so will the fish. That fish will go without food and remain in health, or retain their vital and reproductive powers unimpaired, we have no reliable evidence. Such evidence as there is points the other way. The better the food supply, the more the fish flourish. This will be seen at once by considering the case of making a new pool or lake. When this is done and trout are first put in, they grow with extraordinary rapidity, and tales are told of what wonderful fish Loch Leven trout are. This is true: if they have enough to eat, they will grow at a very rapid rate. But, so far, the evidence has been that the fish first put into the new pool grow very rapidly, and the average of the first year's take is very high, but the average gradually falls off until it reaches a very small proportion of what it originally was. The reason is that the first fish put in had more food than they could eat; but while the food remained a fixed quantity, the fish increased in numbers, and so, not having all they could eat, they fell off in size, and this process went on, fish increasing in number, diminishing in size, until a point was reached at which the size of the fish remained stationary,—very small, that is, just what the food would support, and no more.

But size is not the only thing that depends on food; the reproductive powers of fish are, to a great measure, also largely influenced. It may be laid down, as a rule, so far as regards *Salmonidæ*, and I believe it also applies to other fish, that if the fish are well fed the number of ova they produce is larger than if they are insufficiently fed. For instance, it is said that a trout has about 600 ova to a pound. A well-fed trout might have 650, and an under-fed one 500. It is therefore impossible to lay down, as is often done, any rule as to what quantity of ova a trout will produce, for it depends to a great extent on its food. Pisciculturists recognise this, and feed up the trout on which they rely for their stock of eggs. They want to get the largest number of ova out of the fish, and to do this they are aware that the fish must have the necessary quantity of food; fish will *live* on very little indeed, but they will not thrive; if the producing powers of the fish are to be fully developed the fish must be fully fed.

Nor is the number of ova the only question. Food has a most important influence on the development of ova. Fully fed fish will quickly develop their ova, that is, will be ready for spawning much earlier than insufficiently fed fish. This is recognised also by pisciculturists, and they feed the spawners in the summer much or little, as they want them to spawn early or late. I do not know any figures on the point, but I am quite sure that the time of spawning fish can be accelerated or retarded by the quantity of food they get. To put the matter in another way: in those rivers where trout spawn early, and the spawning is over early, the fish are well fed; while in a river, where the spawning season extends over a long period, there is not sufficient food for the fish. The stronger fish spawn first, as they get the most food, so their ova are developed first; then come the others, until the weakly fish spawn last, and under the worst possible conditions as regards the state of the river.

Another point arises on this, which, so far, has not received much consideration. Do the late-spawned eggs produce as healthy fry as the early spawned ones? It is a point on which there is but little evidence, for the experience of pisciculturists, who *arrange* to have their ova ripe at different times, does not really bear upon it. I can only speak with regard to salmon, and there the late spawners do not produce the same percentage of fertile eggs as the early spawners; but I am inclined to think that this does not really bear on the point, and is due to other causes, such as (1) the late female fish being more liable to injure themselves at weirs in their efforts to pass over, and (2) the imperfect fertilisation of the ova, as the males who are left are mostly spent, or nearly so. With the trout what is wanted is some evidence to show whether in the same stream the percentage of eggs taken from a late-spawned fish that hatch out is the same as in the case of the early spawned. As far as I can express an opinion, but I have not sufficient data on which to speak with any confidence or certainty, I should say, No. There is also the further question as to the strength and healthiness of the alevin and of the fry. I believe it will be found that the late ova do not produce in either of these particulars such good results as the early ova; that is to say, that ill-nourished fish are not so good for breeding purposes as well-nourished fish. As all breeding fish require extra watching, it follows that if the stock of fish and the stock of food bear the proper proportion to each other, the spawning would be got over in a shorter time, and with better results than if the stock of fish was too large for the food; that is, a due care to have the right proportion of fish and food means less expenditure on preservation. The matter is one that deserves far more attention than it has received; for by it a great deal might be done in getting more efficient protection for our spawning fish than they now receive, and increasing their productiveness, by securing that the spawning season is not unduly prolonged by insufficient feeding.

On all these questions we have much to learn: the food supply lies at the root of it all; and it may be taken as an axiom that it is impossible to get as much out of a river as could be got if the food and the fish were properly proportioned. Here a point arises which deserves notice. It will be said the effect on the productiveness of the river is all very well,—that may be so; if the river is regarded as a food-producing farm then it may be of the highest importance; but if the river is kept for sport, will not the fact that the fish are well fed prevent them taking any artificial bait so well as they would do if they were hungry? Here again there is but little evidence; but in my opinion the answer is, No; well-fed fish rise to the artificial fly and are as easily caught as ill-fed fish. It may be difficult to explain, but most fishermen will agree that well-fed fish are not on that ground more shy than half-starved fish—it is more the kind of food than the quantity of food. The question as to a fish rising or not depends far more on whether its usual food is flies than on the quantity of flies it has had. A fish which usually feeds at the bottom will not by hunger be turned into a quick-rising fish; while, on the other hand, hunger will not convert a fish that is accustomed to feed on flies into one that will forsake flies for a minnow. I say nothing as to a worm.

If, therefore, the importance of food is admitted—and no one who has paid any attention to the subject can deny it—the next point is to consider what is the food of the fish, how it can be developed, how it is liable to be decreased.

Of food there are two great divisions—the food on the surface, and the food beneath the surface of the water. So far as regards the prosperity of the river, the latter is the most important; so far as sport, the former. Flies depend, to a very great extent, on the vegetation on the river or on or near the banks. Hence it is that the flies on different streams vary greatly; but probably the variation is more in number than in species, in quantity than in quality. Certain flies are found on most rivers, but whether in sufficient quantities to be an important item of food supply or not depends on local circumstances. For instance, on some rivers only one or two casual specimens of the may-fly appear, and there is no may-fly season. On others the may-fly is abundant. The same might be said as to other kinds. Flies may be divided into local and universal; local such as the may-fly, universal such as the cow-dung. It must be obvious that any change in vegetation, or in the conditions under which the larvæ of the flies are produced, must affect the stock of flies, and hence the food supply of the river. For instance, a common experience is that a place near a ford, which formerly yielded rising fish when certain trees were standing, no longer yields them, when these trees are cut down. It is usually said that cutting down the trees allows the fish to see the fishermen so much more plainly that it is useless to fish there, now the shelter is gone. This may be a part of the reason, but it is only a part. The trees were a great source of food supply; grubs and flies and insects were always falling from them into the water; these attracted the fish; now this supply is gone, the fish are attracted no longer, and are not on the ford as they used to be.

The change in the conditions of agriculture has also changed the food supply. Drainage has produced better herbage, but has led to the extinction of plants on which the larvæ of some insects fed. It follows that the stock of those insects has either decreased or disappeared. The higher and sudden floods caused by drainage sweep from the brooks and ditches on the highland the stock of food that was gradually accumulating for future distribution, and a long time has to elapse before the stock is replenished. A dry season comes with no rise of water and no food brought down; all these things have affected the food supply and also the stock of insects on which the river used to depend.

It may be urged that new sources of supply arise in place of the old ones; but they do not, or, if they do, the quantity of food produced is not what it used to be. For instance, if any one follows out the regulations and orders the Board of Agriculture give as to the destruction of grubs, it will be found that they involve in many cases the destruction of so much food for the river. This, it may be said, is a necessary condition of the times in which we live, and the fish being the least important must go to the wall; but, granting this, still means might be found to keep the fish alive.

It may be taken for granted that on most streams the conditions of modern life have decreased the food supply, and it is difficult to see how as regards flies and surface food the difficulty is to be met.

But the more important part is with regard to the food under the water. The water snails, limnea, the caddis, worms and the various forms of life that exist in our rivers, have also been largely reduced from various causes,—probably the most serious are pollution and abstraction of water; but here again the great development of drainage has something to do with it. For a period during each year, varying with the rainfall, the average height of our rivers is lower than it used to be; this is only saying that the floods run off quicker than formerly. But the result is that backwaters and places that used to be the breeding grounds for a quantity of food are now left dry and produce hardly any; the area of the rivers being smaller, the food-producing capacity of the rivers is smaller, as these parts that are dry produce little if any under-water food; consequently while the supply of fish has possibly increased, the supply of food has decreased and the rivers are so much worse off. This process, although not going on so rapidly as it did some years ago, is still progressive. And from what has been said it will be seen that both great sources of food supply, surface and under-water food, are not and cannot be as productive as they used to be. It will be asked, how can these be dealt with; and the question is a difficult one to answer. Food can certainly be produced artificially, but whether in such quantities and of such quality as to be really useful is very doubtful. Persons who are interested in each river should try to ascertain what are the sources of food supply of the river, and, having found these out, should see that they are not further depleted. Water bailiffs are never instructed to observe as to the quantity of fly, the date of its appearance, whether it is less or more than it used to be; whether new kinds of fly appear while old ones disappear; whether the backwaters, ditches and shoals are left more dry than they used to be. All these are points the Boards have to learn, and, having learned, to see if there are any backwaters or places that used to be sources of food supply which from some artificial reason have ceased to be so and could be made available again. In one case a backwater ran round a meadow for about a mile and bred an immense amount of food; one flood brought down a tree which got washed across the upper end of the backwater and remained there: the tree soon gathered silt, and in about two years the place was silted up so that no stream went into the backwater; the result was that it began to silt up at the other end, and soon became quite detached from the river, thereby depriving it of a valuable source of food supply. This is only one instance of cases that are occurring daily. Water bailiffs never note this; it is not their duty, as they are not ordered to do so; but if they did, and these places were kept open no harm would be done to any one, and great good to the rivers. Much that has been lost can never be replaced; but that is no reason why account should not be taken of what we have left, and that retained and preserved as far as possible.

It would be beyond the scope of this book to try to set out the flies that are usually found on our rivers, and which are the all-important ones to preserve and increase, or the different kinds of water insects and their larvæ that are the favourite food of fish, the water snails and molluscs which are so important an article of diet; but a water bailiff or keeper should be taught to look for them, to know the plants on which they feed and the larvæ feed, and to take note if the plants are decreasing or increasing, if the larvæ are becoming fewer. It is only by attention to these details that the information as to food can be obtained, and it is vital to obtain it. No real improvement in our fisheries can be made until we possess it. It seems there is one chance of an increased source of food supply arising, and advantage should be taken of it when possible. The culture of watercress is being urged as a matter that should be developed." Nothing produces more fish food than a watercress bed. If watercress culture becomes a more popular form of utilising low-lying land, it may be, if care is taken, a most valuable means of replenishing our rivers with food for fish.

Another means is planting. All trees and bushes give their quota of food, and while every tree cut down removes a food supply, all plantations increase it. " One instance of the effect of a plantation on a river is within my own knowledge. A stream comes down from the Welsh hills, which are open, bare and uncultivated. A large larch plantation has been made. Above the plantation the trout average seven to the pound, below they average five, and the difference in my opinion is entirely due to the quantity of food the plantation turns out into the river. "

It may seem far-fetched to say so, but the use of the mowing machine has in many places affected the food supply. When meadows were mown with a scythe, bits were left here and there, ditches were more frequent and were kept open, and a good deal of rough grass was left round the ditches. Now there are no ditches. The meadows are mown as smooth as a board ; and the meadow, from the time the mowing machine goes over it, ceases to be a food-producing area for the rest of the year. If as much of the high grass near the river and the ditches is left as can be, the evil would be sensibly lessened. Another point is to see that the drains and ditches that flow into the brooks and rivers are kept open. Every ditch in which there is water, especially if it be running water, produces a certain quantity of food; if the ditch is by any means cut off from the stream, the food supply is cut off, and the river is so much the poorer. It must be for the common advantage, both of farmers and those interested in the river, that all their ditches should be kept open ; but it seems to be no one's business, and no attention is paid to it. It is idle, perhaps, to complain of modern modes of cultivation and farming; but, curiously enough, the rivers have suffered both from high farming and from the present slipshod system that prevails. The substitution of pipe drains for open ditches has caused the destruction of much food; for the ditch, if it be not actually done away with, can no longer be regarded as a food-producing area, the water being poured off by pipes brings little or no food with it. Even if it does bring any, the drains all discharge at once, and are then practically without water until the next series of storms; so that if there is any food sent down it is all consumed in one or two days, and no more comes until the next flood; while with the old ditch every day food came down, every shower brought down something, and the food was more abundant and more evenly distributed. Instead of having food daily or weekly, a regular supply regularly distributed, under the new conditions on one or two occasions at uncertain intervals there may be plenty, at all other times there is a scarcity. High farming has thus produced two evils: it has cut off food supply, it has altered the distribution of food. But the slipshod system of farming that agricultural depression has produced has tended still further to affect the rivers. In the first place, a great deal of the drainage that was done has become quite useless, from drains being stopped up or getting out of order, running for only a part of their length, and only bringing into the river a portion of what they might do. From the defective state of the drains much that ought to reach the river does not. Other causes might be mentioned that all tend to less food being produced than used to be the case. The decrease in the supply of food makes the available source of supply all the more important, and Fishery Boards and fishery owners do not in the least seem to realise this. For example, in rivers where the weeds have been cut, they are cut without any system, and without any regard to the fact that they are a great food-producing source on which the river has to rely. It often happens that a slight delay in cutting would mean a large increase of food; for instance, if a lot of fly were about to hatch out, the cutting of the weeds means the sacrifice of that lot of fly; and not that alone, for if the fly is year after year destroyed in that way, the quantity must suffer and fly become scarcer and scarcer. It is no unusual thing to hear persons who live on the rivers say, "there is no such supply of fly as there was when I was a boy." How can there be if year by year it is deliberately, perhaps not intentionally, destroyed?

Although it is extremely difficult to increase the food supply, yet something ought to be tried.

Planting has been urged as a remedy for so many things that it seems idle to urge it for fish, but it would help a stream if plantations were made near it where possible. If the grass on the banks is allowed to grow, it will do much to attract insects, while if it is uniformly cut they cannot be expected to go near the stream. But above all things the stream should be kept at its normal size and not allowed to be reduced ; a reduction of the area means reduction of food. Pollution again has done much to destroy food and to destroy streams. In fact, all the conditions of modern life seem to militate against the old source of food supply for our rivers.

What have our authorities done while our fish are being starved out of existence? They have tried to increase the number of starvelings. The Freshwater Fishery Acts have increased the number of coarse fish in our rivers, but they have spoiled the quality. We have far more fish between one inch and three inches than we used to have in the rivers ; but these require to eat—they can get just enough to keep life in them, not enough to make them grow. The official remedy has been, in a time of scarcity, to increase the number of mouths to be fed. It has not been a success.

One point deserves notice: how far does the change that has been going on affect the habits of the fish, as there is less surface food? Do the fish rise less freely than they used to do? On this point, of course, "*quot homines tot sententiæ*;" but my own opinion is, they do. It is not that the fish have become so much more educated that they require the dry fly to be caught; it is that they feed less on flies than they did, and care less for them, and will now only rise if they can be tempted with the most dainty morsels. Their main feeding is done not on the surface, but under the surface; and year by year this becomes more so. The increase of small fish has put before the large fish a source of food supply that did not formerly exist, and they have preferred cannibalism to being hungry. But with it their habits have changed; and now the fish that used to rise freely to the fly are year by year becoming scarcer, not so much because they are more fished for, but because they have changed their taste.

On the food supply the whole question of the future of our rivers turns; but so far no Fishery Boards and very few fishery owners have given it the smallest consideration; it may not be possible to do all that could be desired, but it is as well to do what can be done. The following may be laid down as general rules upon which to act.

(1) Always keep the stock of fish well below the food supply; that is, always keep down the stock of fish, so as to be sure there is abundance of food for them. The test for this will be the size of the fish in the river. If there are only very large and very small fish, the stock of fish is above the food supply; if all sizes are fairly represented, the stock and the supply are in some sort of proportion.

(2) See that all back waters connected with the river are kept open, and that nothing goes into them or into the river to injure the insect life.

(3) See that all drains that run into the river discharge freely, and that the discharge does not affect the insect life.

(4) See that as far as possible all trees, plantations, and vegetation remain on or near the river bank.

(5) See that the weeds are only cut at proper times, and in such a manner as not to injure the brood of flies.

(6) Note the different kinds of fly on the river, and if the number increases or decreases, and if new kinds appear and old kinds disappear.

(7) See that the river bed is not reduced, or shoals removed or changes made in it.

(8) It is also useful to note as regards the habits of the fish, as to their rising or otherwise; when there is fly on the water, is it taken or neglected? For one year or two years this would show little, but for a series of years it would become important, especially if the kind of flies is noticed. It is also well, when possible, to locate the parts of the river from which the different supplies of flies come, so that it may be known why it is that any definite supply ceases.

CHAPTER VI

MAINTENANCE

HAVING ascertained the stock of fish and the stock of food, that is whether the river is carrying more or less than it should do, the next step to take is to consider how it is to be maintained. The stock has to be kept up, or should be kept up, to a certain point, but should not go beyond it. It should be kept up at the least cost, and should be of the highest character, that is, if for sport, what brings the highest figures in the market, if for profit, what sells for the most money. So far as these two points are concerned, the preference must be given to *Salmonidæ* over coarse fish. Trout or salmon fishing fetches more rent than coarse fish fishing ; *Salmonidæ* when sold command a higher price in the market than coarse fish ; therefore, whatever a Fishery Board may do, a fishery owner will prefer *Salmonidæ* to coarse fish. What steps must be taken to keep up his fishing? Artificial breeding is costly; is it a necessity? how far can it be dispensed with? and how far can the reproductive power of the river be relied upon to maintain the stock of fish under ordinary circumstances?

It almost goes without saying that the answer to these questions depends on whether or not the fish have proper facilities for breeding. It follows that a correct knowledge of the times, the places, and the habits of fish at spawning times is essential to the due preservation of a river; but it will be admitted by any one who knows the subject, that this is precisely what we do not possess. A general knowledge of the spawning of salmon and trout, and an idea that freshwater fish spawn between March and June —an idea owing its origin to the Freshwater Fisheries Act, 1878, which was the offspring of the Thames Conservancy Byelaws—are really all the majority of us know, and all most of us care, on the matter. Can we then wonder that our fisheries do not prosper, when we are ignorant of the first principles on which we should act? If we had better knowledge of the kinds of fish in the water, they would be kept in their proper proportion, far better than by any amount of watching and at a much less cost.

Salmonidæ deposit their spawn *in* the gravel, therefore it is all important that the gravel should be fit for the purpose. It wants to be clean, without mud or any other substance, not only when the spawn is deposited, but also while it is hatching out; therefore, whatever tends to bring any deposit on the beds does injury to the ova. The deposit settling on the gravel fills up the spaces between the stones and chokes the ova; and this, whether the deposit is silt or sewage. A stream highly charged with silt, if there is a strong current, will do no harm, as the silt is not deposited to any appreciable extent; but as the current is reduced, the greater is the deposit, until at last the deposit becomes very injurious. A familiar instance of this is in the case of salmon spawning in the channel below where a weir diverts the water to a mill and the point where the water from the mill rejoins the river. A fresh almost invariably brings the migratory fish into the part of the river leading up to the weir, and when they cannot surmount it they spawn below it. At first all goes well; the quantity of water coming over the weir keeps the channel scoured and prevents the silt from being deposited; but as the fresh runs off and the river falls, the water becomes less, the stream becomes less, and the deposit greater; and if the river is heavily charged with silt, a good deal of spawn will perish. This furnishes a reason for inducing the fish to ascend as high up the stream as possible. In most salmon rivers, the upper waters are either on moorlands or on lands where the waters are not charged with silt to any great extent. The peat in the water does, comparatively speaking, little harm, as although it is deposited largely on the gravel and the bed of the river, it does not cake on the bottom like silt, and so does not choke the ova. Experiments have shown that ova will hatch out with peat in suspension in the water, while they will die with the same quantity of silt. It therefore follows that it is all-important to enable the migratory fish to pass from places where they might spawn, and, where if they did, their spawn would be lost, to places where they could spawn with comparative safety from the danger of being choked.

The danger has become intensified in the last 20 years. The discharge from sewers produces a form of slime worse than silt, because it is finer, fills up the crevices closer, and because it not only chokes but also poisons. In estimating the damage done to a river by pollution, persons usually think it is a question of whether fish are or are not killed, wholly ignoring the far more serious question as to what ground is spoilt and what ova destroyed. It is important, as Parliament has recognised, to give the fish free access to the spawning grounds; but the free access is useless if, when the fish have spawned, their ova are destroyed; yet, as the law now stands, there is absolutely no provision to guard against this danger, and Fishery Boards take no heed to it. It is illegal to disturb a spawning bed by moving the gravel; it is quite legal to ruin it by discharging matters into the stream that cake together and kill every ovum in it.

It is important also to see as far as possible that fish only spawn in suitable places, where there is to be a sufficient quantity of water, until the ova are hatched out. Of late years this has become a great and increasing danger. The fish are in the winter months led up into places that appear well adapted for breeding. They spawn there, and, perhaps, for the first two months all goes well; the beds are well covered with water, and a satisfactory result may be expected from the spawning; but a dry February ensues, and the river drops almost to summer level, the shoals become bare, and the result is every ovum dies. It is hard to say which is most destructive to a river, the beds being rendered useless by silt, or being rendered useless by becoming dry; but by both these causes a very large quantity of spawn is annually lost to our rivers. This last cause is to some extent preventible if Fishery Boards will only use the powers the law has given them. The Salmon Fishery Act, 1873, gives Fishery Boards power to erect gratings at the mouths of unsuitable streams; and if this was exercised and properly carried out, a great deal might be done. Only two cases are known to me where it has been done. There may be more, but there are very few: not only is it not acted upon as it should be, but the Boards, as a rule, take no steps to find out the cases where it should be put in force. It is not too much to say one-half the Boards are ignorant of the places where the fish spawn in their districts, and the other half do not know if any fish spawn at all. Yet it is difficult to imagine greater injury to the fisheries, year after year, than must follow from a series of bad spawning seasons, which inattention to a few plain facts must of necessity produce.

Although these rules apply mainly to *Salmonidæ*, they apply in a lesser degree to other fish. No one knows where these spawn, and no one cares, no steps are taken to protect their spawn. The great quantity of spawn that coarse fish have allows a large margin for loss; yet still, after making all allowances, the destruction is enormous. Probably, the usual agricultural operation of cleaning out the ditches that communicate with the rivers in the spring kills large quantities of spawn. It is very likely a good thing that it should be so, as otherwise such a quantity of fish would be hatched out as would make things worse than now; but the point is, not that the fish ought not to be killed, but that if they are destroyed, the Board, or the authority having charge of the river, should be aware of what is taking place, and should regulate it or stop it if required. At present, they are in happy ignorance of everything of the kind.

Another rule as to spawning which applies chiefly, if not entirely, to coarse fish is, that, if it is wanted to increase the stock, all weed cutting should be regulated and done on some fixed rule, either as early or as late as possible, that is, either before the fish have spawned or after the ova are hatched out; that, as far as possible, making up banks of rivers and ditches, and other necessary works involving the removal of roots, branches, and disturbance of the rivers or waters, should, when practicable, be done in the autumn or early spring—not in the late spring or summer.

The reason is the same as that already given, —that the spawn already deposited should not be disturbed. But there is also another, that the shelters for the fry, when hatched, should not be done away with.

The spawning season should be taken advantage of for keeping down any particular kind of fish it is desired to reduce in number. Something has already been said of killing down pike in backwaters in February and March, when the death of a pair of pike means a considerable reduction in numbers of the young pike. It need not be repeated that later it is only the individual fish that is killed. A pike carries a large number of eggs to the pound, and the proportion that hatch out are larger than in the case of *Salmonidæ*. They breed in places less likely to be disturbed and less liable to all the dangers to which *Salmonidæ* are subject. Probably an old cannibal trout will do as much harm in a stream in the way of destruction as a pike; but the real injury the pike does is this, that his reproductive powers are double or treble those of a trout; that while the trout, at least in his youth, is not wholly a cannibal, the pike is always so from his cradle to his grave. He has his office and duty in a stream in keeping down the number of weakly fish; but a very few pike will do all that is required of them in this respect, even if any are required at all.

In some streams during the time coarse fish are breeding a good deal of damage is done by wading. A person who walks along a shallow disturbs and often destroys a quantity of spawn, especially where the ordinary water-weed is growing. It is done quite unintentionally, but it causes a good deal of injury to the spawn. By the law as it now stands persons may not use a gaff during the breeding season, from the injury it may do to breeding fish; and the same principle should be extended to not allowing persons to wade during the late spring and early summer, on account of the injury they may do to the spawn of the coarse fish when it is desirable to preserve them. In the same way no draught netting should be allowed at this time. The bottom line of a drag net going over the bed of a stream does far more harm to a river by the fry it kills and the spawn it disturbs than by the fish it catches. It is not a question whether a dozen or so of fish remain in or out of the water but whether the spawning season has not in a great measure been nullified by the disturbance of the river beds.

Although a great deal that relates to fish spawning is beyond the power of Fishery Boards to control or regulate, yet a good deal may be done in certain ways to improve it. One great thing as to *Salmonidæ* is to prevent the beds becoming too crowded, which is usually the case immediately below some obstruction to the upward passage of fish. Fish try to surmount the obstacle, fail, and then spawn below it. Another lot of fish come up, make the same attempt with the same result, and they too spawn on the same beds that should be kept quiet, and on which the ova already deposited should be allowed to hatch out. But the new comers disturb the beds, deposit more ova, which, in their turn, are more or less disturbed by the next lot of fish. This process goes on all through the season; and the Fishery Board thinks every thing is well, for so many pairs of fish have been seen spawning, forgetting that it means that the new comers are only undoing the work of the previous spawners. The only way to obviate this is by providing easy means for the fish to pass over the obstacle. If this is not done, the beds below the obstacle will be spoilt by successive lots of spawning fish year after year. It must be borne in mind that if the first run of fish is not able to get over the obstacle, none of the subsequent ones will be; the first fish that ascend are stronger, more vigorous, and healthier, and the roe is not so far developed as in those that come later. If the early fish cannot get up, the later ones certainly cannot, as being more advanced and weaker they are in a less fit condition to travel. The beds below the obstruction should be left for these, while the vigorous fish should be sent up higher. It will be said that it is impossible to distribute the fish in the way proposed; but it is not by any means so: it is only a question of money and trouble. In many streams a grating could be placed at the mouth, and the fish let up or excluded as may be required. A very little will turn fish either into or out of a particular stream. One of the upper tributaries of the Severn used to be a splendid breeding ground for salmon, then suddenly the fish forsook it and never went up. On looking at the mouth it appeared that some flood had brought down stone and silt, which quite altered the entrance to the stream : instead of being one deep channel, the water was spread out into a shallow over a gravel bed. For some years the salmon almost entirely deserted the stream. Another flood came, and changed the entrance back into a deep channel and the salmon frequented it again as before. By a very little care and trouble it is quite possible to regulate the stream so far as the *Salmonidæ* are concerned. But it must be borne in mind it is impossible now to do it, as it is a criminal offence even for the Board of Conservators, though they may know that to let any more salmon into a stream will do harm, to take any steps to keep them out. When one knows that early fish have gone up a stream and have spawned well, and that the beds are full of spawn, which is nicely maturing, it is exasperating to find that one must run the risk of a prosecution, or allow all the beds to be turned over by another lot of fish and the spawn wasted. The new lot may be urgently wanted elsewhere; yet one must not take steps to send them there. It makes one doubt the supreme wisdom of Parliament in fishery matters.

As far as it is possible, Fishery Boards should be able to get all their available ground stocked with spawning fish, and stocked in the best way. If it is found, as it will be, that in some streams, from temperature and other causes, ova take longer to hatch out than in others, these streams should be stocked first; but when once a stream is stocked with spawn, it should not be interfered with. If even in these days of enlightened farming, a farmer planted a field with wheat, and after leaving it for a month ploughed it up and planted it again with wheat, and continued at intervals during the winter to repeat the process, no one would doubt what his success as an agriculturist would be, whatever doubts they might have as to his sanity. This is the process that annually goes on in our salmon and trout streams; and persons wonder our fisheries do not improve!

It is of the first importance for our Boards to know all their available spawning ground, to settle into what streams and in what order they will admit the fish, and, having admitted what they consider a proper quantity, then to close them for the season; in fact, to try to conduct the management of the stream on some principle of preservation, not, as now, on one of self-destruction.

As to coarse fish a great deal may be done if Fishery Boards and fishery proprietors will only take the trouble. At present it is illegal to take coarse fish during the close time, but it is not illegal to destroy them; and if the coarse fish are to be kept down, probably the best way to do it is to destroy the spawning beds, so far as may be required for this purpose in each year. Indiscriminate interference with spawning beds of any fish ought not to be permitted, although it is not illegal; but a proper system of regulating the stock of fish, by preventing the increase of those that are too numerous, is one of the initial steps in fishery management. It is necessary to learn, what no Fishery Board and few fishery owners know at present, the circumstances under which fish in the river breed. This knowledge is essential, and of primary importance, and until it is learnt, no real progress can be made. It is impossible without it to say if the rate at which the coarse fish are increasing is or is not too great. Once learnt, the fishery owner has it in his power to say how he will use it, what fish he will or will not allow to breed in a particular year, so that he can make some forecast as to what the stock in the river will be, and what he requires. When this knowledge is ascertained a great step has been made towards placing the fishery on a proper basis. The stock in the river is known, the natural addition that will be made to it is known, or can be roughly computed, and the Fishery Board or fishery owner can say if any external supply is needed to keep up the stock. If the Board find that all their ground is planted, and they have still fish wanting to spawn, they should spawn them artificially. If they find that all their ground is not planted, and they have no more breeding fish, then by all means let them buy what is necessary to plant the ground, or bring up the stock to its proper quantity. Should one stream from some cause not get its natural planting, then plant it artificially. On these lines artificial breeding is intelligible, and may be most useful. But if there are already plenty of fish in the river, either naturally bred or breeding naturally, artificial breeding is useless, and the indiscriminate purchase and turning down of fish without any reason why or wherefore, solely because it is said to be a good thing to do, is at best an idle waste of money so far as the improvement of the river is concerned. A Fishery Board or a fishery proprietor should in a few years be able to say what quantity of fish ought annually to be bred in his fishery to keep it up to the mark, having regard to food, water, and other matters. What that quantity should be can only be locally decided, but, having once got it approximately, the owner should then be able to say each year "I can breed naturally so much *Salmonidæ*, so much coarse fish. This year I am so much over or under the mark. If over with the coarse fish, I will kill down so many, I will destroy so many beds; if under, I will buy so many *Salmonidæ*." A Fishery Board should be able to say, "We ought every year to have at least 100,000,000 ova, or whatever may be the number decided on; we have got 8,000,000 in stream A from so many pairs of fish, 20,000,000 in stream B from so many pairs, and so on. We are 10,000,000 short; as no fish have come into streams X and Y, we will buy enough ova or fry or yearlings to stock those two streams."

These are, I believe, the only principles upon which fish preservation can be carried on. They are not those on which it is carried on now. They imply a great deal of work, a great deal of thought, and a definite system; not the mere dilettante method that is now pursued. But before they can even be thought of, a great change in the law is necessary. It is not too much to say that nearly everything urged here as desirable to be done is, as the law now stands, illegal.

Something must be said on the other side of the account—what can be safely taken out of the fishery each year. At present the idea is to regard the prosperity or otherwise of a fishery by the quantity caught. If a large number of fish are caught in any year, the Board of Trade rejoice and say, "Look what good work we are doing!" But it is common knowledge that our salmon fisheries are getting worse every year, mainly because the catching has overtaken, if it has not passed, the reproduction. That cannot go on. We are living on our capital, and sooner or later there will be an end of it. A certain number of fish ought to be taken every year in every fishery, just as a farmer sells off a certain amount of stock. But that number should be based on some system,—production so much, take so much; not, as now,—production unknown, take all that can be caught. The take, as well as the time and mode, should be regulated just as much as any other part of fishery management. Certain modes of fishing are illegal, and they ought to remain so, and possibly others added to them. At present all that Fishery Boards think of is not the general interest as a whole, but how each party on the river can catch the most fish, quite irrespective of whether the river is or is not injured thereby. What is wanted is some power to say that the take shall not exceed so much a year, a number in proportion to the stock of fish. But for this it is necessary to get some idea of the stock, and of the quantity of fish produced; and that is just what we have not got. There is nothing more delusive as to fisheries than the Board of Trade returns annually published on this point. If any one tries to form an opinion on our fisheries from the Inspectors' reports, he will be sure to go wrong. All that can be said here is, that if any improvement is to be made, it can only be by establishing some relation between production and capture. At present none exists, and none is likely to do so under existing conditions.

CHAPTER VII

THE RIVER

UP to this point, what has been said applies almost equally to the management of a private fishery by the owner as to the management of the whole river by a Fishery Board. Each has to learn, what are the fish that have to be dealt with, where they are to be found, what is the stock in the water, what is the food supply, and how that supply can be best kept up to its proper level. But in considering the river, the points of view differ. The fishery owner regards matters from his own point: either his individual profit, or his individual pleasure; he may, if he is sufficiently wide-minded, consider his immediate neighbours, but he does not get beyond merely local interests, which are, or which he thinks are, identical with his own—how can he and his neighbours get the most rent, or kill the most fish? The larger the river, the more numerous and possibly the more selfish are these different groups of conflicting interests; and if owners are not allowed to do precisely what they want, then, like children, they won't play, or, rather, they will do harm to spite the others in some way. The case of the man who joined with a Yankee in buying an elephant constantly comes home to the mind. If the Yankee was not allowed his own way in every detail of the management of the beast, he always threatened to shoot his undivided moiety. It was only a threat, as is a good deal of the wild talk of upper and lower proprietors; but it serves to show this, that they wholly fail to recognise or act upon the first principle in fishery management, that the whole is more important than the part.

It is very difficult, not only in fish preservation but in everything else, to get any one who has an interest in a subject in common with others, to regard the matter from the general and not the individual point of view. The disputes of upper and lower proprietors are proverbial, and will probably "never perish out of the land." They are, however, only one form of the difficulty; a far worse one is that of those persons who, very keen and interested in the matter, ready to give much money and devote much trouble to the preservation of their part of the river, yet never will take any interest in the river as a whole. Such persons object to any restrictions framed for the general good of the river, if such restrictions cause them the least inconvenience. For instance, in the use of nets, a particular form of net may be most injurious in certain parts of the river, and comparatively harmless elsewhere. To put it down effectually, it is necessary to prohibit it throughout the watershed. This class of persons never ceases to grumble at the hardships inflicted on themselves individually. What is worse, however, is the man who has a craze on some kind of fish, and insists on preserving it, however great the harm it may do to the river. For instance, a devotee of jack fishing who preserves his jack, may be, although a keen angler and sportsman, a great nuisance and most hurtful to the river. Unfortunately, these cranks are increasing in number, and if they are allowed to go on, they may and will do infinite harm. As the law stands, it does not give any effective power of dealing with them. It is not illegal to turn down pike into a trout stream, or to encourage coarse fish to the detriment of the trout;

yet in each of these cases if the river were regarded as a whole, no one would think of doing either of such things. A case came before me recently of a man who was determined to have a grayling fishery. He had a stretch of water on one of the best English trout streams, and, at great expense to himself and some trouble, he turned down a number of grayling into his water. The result is that he has now fair, it cannot be called more than fair, grayling fishing; but the trout fishing in the stream has fallen off tremendously, and is nothing to what it was, as proved by the fall in the letting value of the fishing near him. It does seem hard that, for pure selfishness, I had almost said cussedness, one proprietor can thus, while carrying out his own ideas, injure the river.

This is only an instance of not regarding the river as a whole; not considering the effect of local treatment. Often with the best intentions in the world, but from ignorance of the effect of the means proposed, great damage is done to a river. For instance, on the Severn, the anglers at Shrewsbury were desirous of getting up a stock of trout; so they persuaded the Severn Fishery Board to abolish all netting in the borough of Shrewsbury. The result is that, not only in the borough, but above and below it for some distance, the river is swarming with pike.

It may therefore be said it is quite impossible to deal with any part of the river by itself. The interests of the whole river must be regarded; and to carry out this principle there are certain rules that should be observed by all bodies who have the charge of a river,—rules which they should impress upon their keepers and bailiffs. Some of the rules are the following:—

1. That, except in the general interest of the river, the central authority should interfere as little as possible with the fish. If a man likes to take non-migratory fish in his own water in any particular way, he should be allowed to do so. Nor should the size of the fish he takes be fixed. He may want to keep down certain fish, or he may want a certain species of fish for a particular purpose, or he may desire to have what he considers a day's sport; and it is difficult to say why he should not, if he does not interfere with his neighbour or with migratory fish. With these the case is different, and other considerations prevail.

2. It follows from this, that the owners of private waters should not be subject to any restriction as

to times of fishing, except such as are for the general benefit of the river. This would render every owner subject to the close time for salmon and trout, but to no other, so far as he was concerned, in his own water. He could then take coarse fish all the year round, but he could not sell them, and he could authorise any one else to take them in his water, but not to sell them. Practically this is the law now; but an effort has been made to restrict owners of fisheries from the liberty the law gives them for the benefit of persons who are not interested in the river. This should not be allowed. It is not necessary for the good of the river. It is only to please certain persons who have no legal interest in the river. Stated in this way, probably all persons will admit its truth; but the way it is usually put does not receive such ready acceptance, —it is said fish should be preserved for anglers, and should be allowed to be taken only by angling. But the obvious reply to this is, Who are the anglers? Why should the owner be prevented from enjoying his property in his own way because there are anglers? The general good of the river we know, migratory fish we understand—but who are you?

3. It equally follows that the more preposterous claim that is set up to restrict the owner's modes of

fishing, when they do no harm to the river, should not be allowed. For instance, it is said he is not to be allowed to use night lines, even in his own pool, stocked only with fish he has bred himself. If a stream runs through it, he may not net out his fish from his own pond. It is obvious that, if these restrictions were enforced, they would be followed by the upset of all fishery legislation. A stream on one's property would become a curse.

4. The time has come for the law, as established on the Thames,[1] and applicable to all rivers, to be recognised and enforced everywhere, namely, that the public have no right of fishing above the tideway, and to make it clear that the old idea that any one may fish in a navigable river, is a vain delusion. The only public right of fishing that the English law recognises is a right to fish in waters that are both tidal and navigable; and even this right is by no means universal. The sooner the rule, which is now settled law, is acted on and enforced, the better it will be for our fisheries and all concerned with them.

5. As migratory fish are no one's property, but belong to the whole river, the authority having

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[1] See Mr. Justice North's decision in Smith *v.* Andrew, *L.R.*, 1891, 2 Ch. 678.

charge of the river has to look after them, and to see that no one owner or set of owners takes an unfair share or a share that will injure the river. Hence comes the difficulty in river preservation, as to how far interference is necessary. The law allows it to a very large degree, but it does not follow that the right should always be exercised. Only such interference as is necessary is permissible. What is necessary interference differs in each river, almost in the case of each proprietor. For the converse of the rule applies here: that the proprietor cannot, by reason of his own ideas, his likes or dislikes, do anything that will injuriously affect the migratory fish. His management of his own fishery in the way he thinks best is always subject to this—that the migratory fish have a paramount claim.

From these rules it will be seen that there must almost of necessity be diversity of interests between the Board and the fishery owners, the extent of which will depend on the view the latter take of the fisheries in the river, and that view will mainly depend on where their property is situated. The lower proprietors care nothing for anything but migratory *Salmonidæ*, and think that the Board have no right to bother their heads with anything else; the upper proprietors so seldom see migratory *Salmonidæ* when they are fit to be, or are able to be caught, that they consider the trout, or even possibly the coarse fish, of more importance. It is no easy matter to balance the scales. It is not proposed here to go into these questions at length, but rather to consider some matters in connection with the river that affect upper and lower proprietors equally, and are every year becoming more important to the fishery interest, whether it be upper or lower.[1]

Up to the middle of the last century it seems that rivers had gone on much as they had always done. A change was however begun by Brindley and the great water engineers, who formed the idea of converting rivers into canals. Carrying this out has in many cases caused serious injury to the fisheries. Before the rivers were made navigable, the fish had a free passage up and down; in this passage they have been obstructed by weirs—which are usually said to have been the great cause of injury. I do not think they were the worst, although they were undoubtedly harmful. The worst was the destruction of the spawning ground for the *Salmonidæ* caused by the deepening of the streams; the shoals and shallows on which they bred disappeared. While they might breed well enough with two or three feet of water over the bed, they could not do so with six or seven. Hence all the lower breeding grounds were cut off, and if the *Salmonidæ* wanted to spawn, they had to go up the stream beyond the point where the river had been adapted for navigation. But they were prevented from doing this by the weirs, and so in both ways they were prejudiced. All the usual spawning grounds were destroyed, to all that remained they were denied access. Hence they fell off in numbers, and gradually dwindled away. This is why the Thames ceased to be a salmon river, and will never become one again; there is no spawning ground. The upper reaches are inaccessible from the weirs, the spawning grounds in the lower waters are done away with by the changed condition of things. In time this would have got rid of the *Salmonidæ*, but to quicken their departure, the shoals that remained were dredged out, so any reproduction became an impossibility, and salmon became extinct.

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[1] In Appendix II will be found a memorandum as to trout and coarse fish prepared for the Severn Fishery Board in October, 1897, which gives these points in detail.

But the change in altering the condition of the river had another effect: it not only did away with the conditions required for salmon, but it also gave increased facilities and encouragement to all those required for coarse fish: the deeper and stiller waters, the pools, the holes below the weirs, all form a paradise for the coarse fish. They have increased and multiplied, and the Thames has become the finest coarse fish river in the country. Any trout there may be are only old cannibals who have dropped down from the tributaries, to remain in some pool seeking what they may devour. The number of trout naturally bred in the Thames at the present day is, if possible, less than the number a casual angler who goes there trout fishing will catch.

The example of the Thames has been followed by the Trent. In a very few years salmon will be extinct in that river also from the same cause; the remaining spawning grounds cannot be reached, the lower ones have been abolished, the river has been turned into a coarse fish paradise, greatly to the delight of Nottingham and Sheffield anglers.

A similar process is going on upon the Severn; only here it is not so speedy in its work, as there are tributaries in which the *Salmonidæ* can breed and the weirs do not wholly cut off the salmon from the upper waters. But the result of the change in the nature of the stream has caused the coarse fish to increase very largely, and the trout are yearly driven further and further up the streams by the coarse fish.

This change in the nature of certain rivers—rendering them less adapted for *Salmonidæ* and more so for coarse fish—is one that Fishery Boards and fishery owners are powerless to prevent; but they need not accentuate and enforce it by regulations in favour of the coarse fish, which is what they have done and are doing. Perhaps they are not so much to blame as Parliament, which has tried, doubtless with the best intentions, to encourage the coarse fish by legislation, and given the Boards power to make rules for their preservation: these, having the power, could not resist the temptation to use it, and have thereby done much mischief.

Therefore, what has been accomplished is that all changes that can be made in the condition of a river are as a rule in favour of coarse fish and against *Salmonidæ;* and that the *Salmonidæ* will not be able to hold their own unless they receive assistance. It is the obvious duty of Fishery Boards to give that assistance; for they are formed and they exist in the words of the Act creating them, "to execute such works, do such acts, and incur such expenses as they may deem expedient to be executed, done, or incurred, for the protection and improvement of the salmon fisheries within their district, the increase of salmon and the stocking of the waters of their district therewith."[1] This being so, they are bound to carry out their duty, whether the fishery owners like it or not.

The first point to ascertain are the limits within which coarse fish are found in the river;—have they spread over the whole of it, or are they confined to part? If they have spread over the whole of it, the case is one of difficulty; for, except with the consent of the fishery owners, the Fishery

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[1] 28 and 29 Vict., c. 131, sec. 27, sub-sec. 5. The Board of Trade, in the edition they have issued of the Fishery Acts by Mr. Fryer, their Inspector, have tried to read into this section the words "or freshwater fish" after salmon, on the authority of 47 Vict. c. 11, sec. 2; but such a reading is quite wrong. The Act cited only applies to a fishery district for freshwater fish; where such a district has been formed, the conservators in it are to have the same powers as salmon conservators have in a salmon fishery district, and to give them these powers, "salmon" in such a case is to be read "freshwater fish"; but to say that salmon conservators are to protect and spend their money in protecting freshwater fish is an invention of the Board of Trade, or rather of its Inspector. It is, however, valuable as showing the direction of the official mind.

Boards can do nothing themselves to keep the fish down. Their powers are purely negative; they can forbid fish being taken in certain ways, and at certain times, but they cannot take a fish themselves or authorise any one to do so for them ; so that they cannot keep down the coarse fish—all they can do is not to help them to increase. The power to keep up or decrease the stock of coarse fish rests wholly and exclusively with the fishery owners, and in this instance the Boards can only act with their leave. In the parts of a river already frequented by coarse fish, their regulation depends on the concurrence of the riparian owners.

If the coarse fish have not as yet spread over the whole district, the matter takes a different light. The reason they have not is usually because there exists on the stream some weir or obstruction over which the coarse fish cannot pass. Although they have and exercise the same powers of leaping and trying to pass a weir that the *Salmonidæ* possess, yet for several reasons, partly because their efforts are made at a time of year when there is less chance of there being water to take them over, they are not so successful as are the *Salmonidæ*. Fishery Boards have now the practical control of all works at weirs and mills, and they can say Yes or No to the question—Shall a fish pass be put in? Usually the matter is looked at wholly from the point of view of the *Salmonidæ;* to place a pass in a weir means to open up so much breeding ground, and so it is clearly an advantage. It is never regarded from the other point of view, that it also admits the coarse fish, and therefore will gradually tend to prejudicially affect the salmon and trout fishing. Here, again, it is impossible to lay down any rule; it is altogether a local matter, dependent on the amount of breeding ground available on each stream. But it is a matter that should be decided after full consideration of all the points of the case, bearing in mind the fact that if the coarse fish are once admitted, the difficulties of getting rid of them are enormous.

Another point that is not sufficiently considered in managing a river is the value of the different tributaries. It is usually said that there is so much spawning ground. Open it out. But this is a very superficial way of looking at the matter. The value of a tributary depends on a number of other matters as well as the quantity of spawning ground. The geological nature of the watershed must be considered. If it is of a non-porous nature, so that all the water rushes off in the first fresh, and consequently the stream is subject to great variation in height, then the stream, however valuable for other purposes, is of comparatively small value as breeding ground; for the chances are the fish will spawn in places that will be left dry before the ova are hatched out, or if they spawn in places always covered by water, the sudden rise of the stream may be such as to wash away gravel, ova and everything. A stream with inferior spawning ground, but with a fairly uniform supply of water, will turn out more fish than a stream with much better spawning ground and great variations in the height of water.

The next point is the nature of the spawning ground. Is it adapted for salmon, migratory trout, or brown trout? The rule is that the gravel best adapted for salmon consists of stones of a larger size than the gravel for migratory or brown trout, while the migratory trout want gravel larger than the brown trout. If driven to it, salmon and migratory trout will both spawn on banks where there is small gravel, but they do not do nearly as well, that is, the quantity of ova hatched out is not nearly so large a percentage as when the gravel is larger and more adapted for them. A stream may be well adapted to one kind of *Salmonidæ* and not to another; the obvious course is to keep it for the kind to which it is best suited. As migratory *Salmonidæ* usually ascend in separate shoals, by a properly regulated system, there would not be any difficulty as to this, but it would be illegal to do it as the law now stands.

The next point is the temperature of the stream. Nothing varies so much as this: two streams close together will vary considerably in their temperature; the consequence being that as the incubation of the ova depends on the temperature, the ova in the one stream will hatch out quicker than the ova in the other. If for no other reason than the cost of watching, it is the interests of the Boards to get the ova hatched out as soon as possible; but there is a further reason. The earlier the ova are hatched, the stronger and healthier are the fry; the sooner they migrate seawards. It is for the interest of the Boards to ensure the stream with the highest temperature being always stocked with fish. At present there is not a Fishery Board that can tell the temperature of any of its streams, much less the difference in their temperatures, or is aware, probably, that there is any difference. Most Fishery Boards have far too small a staff of watchers; it is their misfortune, not their fault, that this is so, but their funds will not permit them to have more. When there is a good stock of breeding fish in the river, it is an anxious time with the officials, as they know the incessant temptation there is to poach the fish. As a rule the temperature of the main stream is higher than that of the tributaries. A fish may be almost ready to spawn, and if kept in the same temperature, might spawn in a week, but a change into a lower temperature would delay the spawning; it may be only for a few days, it may be longer. But when once a fish has left the main stream, its life is in danger. Those who are aware how a gaff can be used in the hands of one who knows its use will best appreciate this, and will recognise that a question of days is often a question of lives of the fish. A Board's first object should be to get the fish spawned as quickly as possible. If the Welsh shepherd must take his toll with the gaff, let it be of fish that have spawned, not of fish that are going to spawn.

Another important matter on some of the tributaries is, who the landowners are. If a stream flows through a large estate and is owned by one or two proprietors, the fish are usually fairly safe. Keepers are aware that one form of poaching brings on another, and turn away all trespassers, not so much for the sake of the fish as on principle; but if the stream is owned by a number of small proprietors, there can be no protection for the fish. Each man has a right to be on his own bank beside his own river, and if the Fishery Board had an army of water bailiffs they could not save the fish. I once met a great friend of mine, a Nonconformist minister, walking up and down a field he rented by a river in which salmon came up to spawn. It was in December. He seemed lost in the contemplation of the river, and told me he was composing his sermon for Sunday. There had been some rain, and a fresh was just running off. I walked with him up and down once or twice. He talked to me about the beauty of water; that the stream resembled the Divine mercy, in clearing away the dirt from the water as that cleared away the iniquity of the world. At the top of a pool he stopped and said, "Did you see that?" Before I could say "What?" his gaff was in a salmon. I came to the conclusion that the fewer fish that went up into that pool the better for the river. This is only the case of hundreds of tributaries to the salmon rivers of England and Wales; they may have every natural advantage for breeding fish, but it may be wholly undesirable to let more fish than can be helped frequent them.

Again, there is the question of food supply to the tributaries; a stream may be all that is wanted in other respects, but if the food supply is bad, the fry will mature more slowly, will remain longer in fresh water, will take more time before they are turned into productive fish, than if they were in less favourable water and better fed. The percentage that becomes grilse will very likely be less than the percentage that does so in a less favourable stream.

In considering how to develop a river, all these points ought to be regarded; and the more they are, the more important they appear. Whether a stream belongs to a fishery owner or is under the control of a Fishery Board, it is impossible to improve it without taking these matters into account. The popular idea that there is a river and there is spawning ground is, like most popular ideas, of but little practical value.

But, when the spawning grounds have been examined and their value ascertained, the duties of the Board in connection with the river are only beginning. How are the fish to reach them? The law has recognised this difficulty, and has provided two ways: (i) Prohibiting all fishing during a certain time of the year, so as to enable the fish to reach the spawning grounds; (ii) Prohibiting all fishing during a part of each week for the purpose of giving the fish a chance of getting up the river.

Unfortunately, both of these measures have been taken in a half-hearted way, and have proved by no means as effectual as they should. The Legislature thought that the same time would do for all rivers large or small, whatever was the stock of fish in them. While September to February may be ample close time for a small river fully stocked with fish, where the greatest distance they have to go may be some fifty miles—where they have spawning grounds within a few miles from the head of the tideway—where there is no fresh-water netting, and where once past the tideway the fish are safe; it is wholly inadequate for a river where the fish have to go 200 miles, where for the first fifty there is no spawning ground, where every inch of fresh water that can be, is netted, where a fish when seen is hunted until it is caught, where netting takes place day and night, where every one's object is to catch every fish, and where the number of fish in the river is very small. To say that the one river could do with the same close time as the other was only to show how ignorant of the subject of fish preservation the framers of the Act were. If they had said the time September to February shall be the irreducible minimum, but in each river there shall be an additional time, varying with the size of the river, the stock of fish and the number caught, something might have come of it. But the reverse course was followed. Fishery Boards were allowed to alter the close time, and they have altered it, so as to make it apply to times when no fish are in the river or are likely to be, with the result that fishermen are able to catch all the fish that run up to spawn as they are entering the river. And then it is asked, Why do not our salmon fisheries improve? The Board of Trade have done many things with regard to fishery management that it would be a mild expression to call stupid; but they have done one thing for which they are entitled to all credit,—they have consistently refused to alter the close time as the fishermen wanted to have it altered, so as to enable them to kill a larger number of late salmon. The only way a stock of *Salmonidæ* can ever be got up in our rivers, is by some such rule as this: that the fishery season shall begin on the 1st of March and terminate on the 31st of July, unless the Board can prove to the satisfaction of the officials of the Board of Trade that their stock of *Salmonidæ* is over so much—a figure to be fixed for each river; then as long as it so remained, a fortnight's more fishing to be allowed; if over so much, another fortnight's; in the first case, to the middle of August; in the last, to the end of August; but on no account to extend beyond the 31st August. Such a rule would make it the interest of all concerned in the river to get up a stock of fish and maintain it, and force them to use all necessary means for the purpose. Now they need do nothing, and have no object for doing anything. It is quite true there would be difficulties in the details, but these might be got over if it were really desired to carry out a satisfactory change. To some extent the Boards might take a step towards doing this under the existing law, but the opposition would be very great, and it is doubtful whether the Board of Trade has enough backbone to support a Fishery Board in doing what would be for the good of the fisheries, if the proposal was very unpopular and might cost Parliamentary votes.

A weekly close time is and must be in most cases a failure, for this reason—merely stopping of the fishing will not make the fish run up; the changed condition of our rivers, to wit, the destruction of the lower spawning grounds, has done away with the reason for the weekly close time. If net fishing were confined to tidal waters, then a weekly close time might, even now be effectual, as the fish coming up on the tide would pass all the net stations, reach the head of the tideway safely, and be free from capture; but as long as fresh-water netting is allowed, all that a weekly close time does is to bring the fish up past the tideway nets to the fresh-water nets, where they can be more easily caught. As it now stands, instead of being a means for preserving the fish, it is a means for destroying them. In the tideway, netting can only take place at certain states of the tide, and the fish get a chance, it may be only a poor one, but still a chance, of passing the nets; but once get them out of the tideway into a fresh-water pool, there is no limit to the time of catching them. They are known to be there, and they have to come out. On the Severn, in the fresh water above the tideway during the summer, the nets are often only worked on Mondays and Tuesdays, just after the weekly close times, because in their draughts on those days, all the fish that the weekly close time brought past the tidal nets are caught. An additional weekly close time then would mean an additional day's netting for those nets. But the river does not and never will receive any benefit by a weekly close time as long as fresh-water netting is allowed.

If fresh-water netting cannot be abolished, it should at least be regulated. Now, if a person takes out a licence, he can, with the owner's leave, net anywhere in the district. A stop would be put to this if, within a defined area, a licence were given at a small charge,—to be largely increased if the same net were used outside this area. This could be done under the present law, provided the Board of Trade approved. Another change is urgently wanted,—power to set apart certain places in which there shall be no fishing but angling, except by the Board. At whatever rate salmon travel, if they have long distances to go, there should be places where they can rest in security. At present, this can only be at the confluence of streams where the fishing is not private. As modern decisions have settled that there is no fishery in fresh water other than private fisheries, the provision is in practice useless. Except for a short distance above and below dams, there is no power to prevent the owner, or persons authorised by the owner, from fishing.

The Fishery Boards should have power to make such places along the course of the river. In most instances, the owner would find it was really a good thing for him, as such places would become good angling catches, the rent for which would probably be worth far more than he would get from his netting for salmon. But if there are any coarse fish in the river, it would never do to abolish netting, for it would then be impossible to keep them down. The experiment has been tried at Shrewsbury. For some distance above and below the town, a bye-law was made by the Severn Fishery Board, abolishing all netting for fish other than salmon. An angling society has bred and turned out quantities of trout. The result is not what was intended, although it was not unexpected by those who had any knowledge of the habits of fish. Nothing was done to get rid of the pike and coarse fish before the trout were turned in; so the part where netting was stopped has become a nice quiet part of the river full of the best food, to wit, young trout, and with deep shady pools such as pike love. That water is now a better pike preserve than any other water for miles round; yet this was hardly what Fishery Boards were formed for. To make the matter worse, the Corporation of Shrewsbury are proposing to put in a weir, to deepen the water round the town, and make it a better pike preserve and harbour for coarse fish, and this in the middle of what is popularly supposed to be one of our great salmon-producing rivers! With this before their eyes, the Upper Severn proprietors ask plaintively, how is it that salmon do not increase in the upper reaches of the river? Why is not our trout fishing as good as it used to be?

Whatever is done to protect *Salmonidæ* in fresh water, it is absolutely necessary that there should be power to prevent such a fiasco as the Shrewsbury one being repeated.

CHAPTER VIII

POLLUTIONS

PROBABLY more rivers in this country are injured by pollution than by any other single cause, and yet the law gives no summary remedy for pollution as such, only for particular kinds of it. If the pollution is to such an extent as to poison or kill fish, then summary proceedings can be taken before justices; but if the pollution is doing far more harm to a river by destroying all the sources of fish life, nothing can be done summarily. Proceedings can, it is true, be taken under the Rivers Pollution Prevention Act; but proceedings under it are of very doubtful efficacy, even if they are successful, and it very often happens that they are not successful. There is still the remedy by injunction in the Chancery Division of the High Court of Justice; but that takes some time to obtain, and is open to two objections, (1) that before it is obtained all the fish are dead, and (2) it is so expensive that very few Fishery Boards and still fewer individuals are willing to incur the cost of applying for it. Practically therefore there is no remedy for the pollution that is most to be dreaded in fishery management, the gradual destruction of food and spawning ground in the river. There are plenty of persons who are both able and willing to try to put a stop to the pollution of our streams, not so much on the ground of fish as on the higher ground of public health; but all river reformers seem to labour under the delusion that if fish are not *killed* things cannot be so very bad,—not bad enough in fact to justify any interference. This is not so. Fish may be killed by a pollution of a very harmless kind. A few years ago a number of fish were found dead in a stream that flowed through a manufacturing town; their death was at once set down to pollution. On inquiries being made and the water being analysed, it was found things were much the same as usual; after further inquiries it was found that a strike had been going on. A number of unskilled labourers had been taken on to supply the places of those who had struck, and these men did not know their work, and had discharged a quantity of boiling water into the stream, which was then at low summer level. This caused the death of the fish, but it was not a case where anything could be done. I can point to a stream which 10 or 12 years ago was a good trout stream, in which a dead fish is never found, but in which the trout are rapidly becoming extinct from the pollution, which is not in itself hurtful. Great spoil heaps[1] from old mine workings are on the banks, and every storm of rain washes matter from them into the stream; the stuff is gradually filling up and covering all the spawning beds and destroying the stream, although it can be said with truth the river is not being polluted, for nothing poisonous is passing in from the mine. There is even a worse case, where a mine company were compelled to erect settling pits by a Fishery Board and made to clean them out at frequent intervals. The mud and slime from the pits were placed on the adjoining banks with the same results as in the former case,—the rain washes a certain portion into the stream: after each storm this settles upon the spawning beds and renders them worse than useless. Yet the process is so gradual that it is very difficult to prove a case on a particular day; and it is very doubtful how far this is an offence against either the Fishery Acts or the Rivers Pollution Acts; and the value of the stream does not justify resort to Chancery proceedings. Instances of the failure of the present law might be given to almost any extent. It will, however, be more useful to consider the evils caused by pollution, so as to show what are the points that require most attention.

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[1] I have lately been informed that the effect of spoil heaps on the banks of the German trout streams, particularly near Strasburg and Basle, has been to remove the dissolved oxygen from the rain water and so most injuriously affect the streams.

First, it must always be borne in mind that it is quite possible by legislation to make the last state of things worse than the first. As an instance of this, the Rivers Pollution Prevention Act may be cited. It was an Act framed with the best possible intentions, but it possesses the defect of most good intentions—that they make matters worse. Before the Act, it is true, a great deal of filth was discharged into our streams, but it was mostly sewage, and pure sewage, although it may be and is injurious to the river in some cases, is not *necessarily* so. Fish, especially coarse fish, will feed off sewage and thrive. But the Act provided that facilities were to be given by local authorities to manufacturers to discharge the refuse from manufactories into the sewers. The result was to change the whole character of the effluent from the sewers. Before, it might not be harmful—it might give a certain amount of food; now it has in many cases become positively poisonous. One instance can be given. It happened before 1893. A large tan-yard had a drain connected with the river, and when the pits were run off the lime-water caused a pollution that killed the fish in the river. Proceedings were taken against the proprietors of the tan-yard, and on several occasions they were convicted and fined. At last they promised to cut off their drains from the river, and the Fishery Board agreed that if this was done they would not press for a penalty. The owners carried out their promise, and called on the Local Authority to receive their drainage into their sewer under the Act. This was done: a worse pollution than before ensued, and the tan-yard people were summoned. Their defence was that they did not discharge into the river, but into the sewer, and they had no control over the effluent after it passed into the sewer. This was held to be a good defence, and the Corporation were summoned. Their defence was that they were bound by statute to receive the effluent; that the sewer had existed before 1876, and they had used the best practical and available means to render the sewage harmless and so were not liable. The means they used was to add more lime. The result is that a pollution that was illegal, and could be and was made penal before the 1876 Act, has, since that Act, and by virtue of it, been legalised, and so remains, unless the 1893 Act can touch it. It will therefore be seen that, with the best intentions, the Legislature, often by not knowing the conditions to be dealt with, do more harm than good by legislation. Nor is this all. From a fishery point of view, the Local Government Board are probably one of the worst offenders in the matter of pollution. Owing to their orders and instructions, a habit has arisen of local authorities putting into sewers, to disinfect them, or to prevent smells, or for other purposes, various disinfecting compounds, which are all more or less, usually more than less, poisonous. A very favourite one is chloride of lime; this, or a dilution of it, is conveyed into the river when the sewer is flushed and the river at its lowest, and the fish are either poisoned or sickened. It is said that this process is carried out at Gloucester to such a degree that the salmon, when ascending the river, on meeting the discharge of the Gloucester sewage, turn back and drop down seaward. Hence arises a beautiful instance of how fisheries are treated. Weekly close time is made law to bring the fish up the stream. It is, however, only effective, or rather is chiefly effective, if there is a heavy storm and a slight rise in the water to induce fish to run up. If there is a heavy storm it flushes the sewers and takes into the river all the Local Government Board's abominations which they are pleased to call disinfectants; these sicken the fish and turn them back. The upper proprietors ask, Why do we not get our salmon? The answer is, because of the Local Government Board.

This is by no means the only or the worst fault of the Local Government Board. They have a notion that if all the effluent from sewers is collected, treated chemically, and passed over land, it can be allowed to go with safety into a river. Like all general ideas, it is not universally true; and the rivers are often very much worse than they were before they were treated by the care of the Local Government Board. For it by no means follows that the chemical treatment is a success from a fishery standpoint, or, if it is in some cases, that it will be so in others. It may do very well for pure sewage, but it will not do for sewage plus certain waste from manufactories. In some of the waste there may be something that affects the action of the chemicals, producing a result that the Local Government Board did not intend. Or it may be that something goes wrong with the chemicals, and there is either too much or too little added to the substance that is treated, and a result not wholly harmless is produced. Or still further, after the effluent from the works has been passed over the very limited area of land the Local Board require the authorities to take, the ground soon becomes so saturated and sodden that its effect on the effluent is nil. Yet in spite of all these contingencies, which may and do occur, the Local Government Board think that persons interested in fisheries are unreasonable if they do not regard with unmixed approval their mode of dealing with river pollution.

From the unfortunate use in the Salmon Fisheries Act, 1861, of the words, "poison or kill fish," it has come to be regarded as a principle that there is no valid cause of complaint by those who are interested in fisheries, unless they can show fish are actually poisoned or killed. There can be no greater mistake; the fish that are poisoned or killed are but a very small part of the injury that is daily done to our rivers by pollution, and while it is possible that some of the Local Government Board schemes may put a stop in some measure to fish being poisoned or killed, they leave the other part of the matter wholly untouched

There are three great heads of injury caused by pollution: (1) to the fish, (2) to the food, and (3) to the river; and it often happens that the injury to the fish is not the most serious that takes place.

Fish are injured in two ways: they are either killed right out or they are rendered less healthy, so that they do not thrive, and will not breed The fish that are killed right out make the most show, cause the greatest amount of indignation, but usually are the least real injury. It is generally an accidental occurrence if many are killed; the bursting of a pipe at gas works is one of the most common forms of death, and this is almost always really accidental, as the waste is of some value. All the fish for some distance down will be killed, but the beds are not poisoned, the food is not killed. The stock of fish is reduced by so much. So many yearlings at so much per 1,000 will not only replace it, but probably may improve the river by getting rid of fish that wanted killing down. There is nothing more aggravating, more calculated to make even a Bishop swear, than to have a stream polluted, in which you have been doing your best to get up a stock of fish, the fish killed, and three or four years' work lost; but it is not an evil that cannot be remedied. I have even known cases in which good has been done. A brook contained a certain number of trout, and a quantity of coarse fish; it flowed through a hop yard. The man who was creosoting the hop poles allowed his tank to run off into the stream. Every fish was killed down to the next mill, and the owner was astonished to find what fine trout there were in it. Determining to have nothing but trout for the future, he altered his weir and mill so that the coarse fish could not ascend. He went to some cost in buying yearlings, and turned them down in the autumn of the following year, thus first giving an opportunity for a good stock of food to get up. In about three years' time he had, and still has, a nice bit of trout fishing, which but for the pollution he would never have had. In such cases where fish are killed, if it is desired to know whether the injury goes further than the fish, care should be taken to see if among the dead fish are any eels, bull-heads, or loach ; if there are not it may be said with some confidence that the damage has not extended to more than the fish. If these bottom feeders are found, and found in any quantity, then worse results may be looked for, as it is clear the pollution has killed not only what was in the river, but also what was on the bottom as well.

Whenever fish are killed by pollution it is worth while, if possible, to make a post-mortem, and to note accurately everything about the fish, both externally and internally. Although experts tell us that fish die so quickly that any examination is useless, it is often most desirable to make one. By discovering the nature of the pollution, it may lead to the detection of the offender. One case will illustrate this. A number of fish were found dead in a stream on which a lead mine had been opened; from the inflamed appearance of their intestines, it looked as if they had died from some irritant poison, but the little water that came from the mine was beautifully clear ; and the mine company positively asserted there was no pollution. An analysis showed a considerable quantity of arsenic in the water in some of the samples taken, and there could be little doubt that these fish had been killed by arsenic. As the water was not taken on the day the fish were found dead, and as the arsenic was only found at times, it was not possible to have a prosecution; but this showed that, when fish are found dead near a lead mine, a sample of the effluent should be *at once* taken. The lesson did not end here. Some time after, another mining company was formed, which opened a lead mine near a brook on the other side of a neighbouring hill. Soon after, a number of fish were found dead. I only saw one of these, and it had no trace of inflammation or any of the appearances of the arsenic-killed fish. The bailiff took a sample of the water, and the analyst, to whom it was sent, reported that, although there was only a very slight trace of arsenic, yet there was some form of zinc in solution that was enough to kill anything, and that the fish were killed by zinc poisoning. I did not feel happy, as my fish certainly did not show such symptoms as should have followed from the analyst's description; but I got his report, in which he had worked out the analysis to some six places of decimals, and took it to an eminent chemist. I told my story; the chemist said, "You are quite right, those fish were not poisoned by the form of zinc mentioned in the analysis;" and on my asking why, replied, "Because it is not soluble in water!" I felt glad that I had seen the chemist before the case came into court.

The easiest poisoning to detect is that by lime; the symptoms are unmistakable;—the fins stand out stiff, there is a film over the eye, and the mouth is usually open. The importance of noting this is that lime poisoning is almost always *wilfully* done to destroy the fish, and is not the result of pollution.

The more deadly injury to fish is not from the pollution that kills outright, but from the pollution that sickens. On some of the Welsh streams on which there used to be lead-mining this can be well seen. There are no mines now, and have not been for some years; but there are heaps of rubbish that have come from the mine works and get washed into the stream. The fish in those streams have an unhealthy appearance; they have never their proper quantity of ova, they never appear in condition; their heads are too large for their bodies. If you examine them, they seem out of condition; the number of their cæcal appendages are fewer than those of an ordinary brook trout, and their vertebræ are often malformed or irregular. All these effects I attribute to the poisoning of the water; it is not enough to kill, but it is enough to sicken, and the fish that exist under these conditions are unhealthy. It may be that the fish are also underfed, as the pollution kills the food; but many of the symptoms cannot be attributed to want of food alone, and are the results of slow poisoning and unhealthy surroundings. It is to this that I am inclined to attribute the existence of a form of trout that at one time was considered a separate species—the hog-backed trout of Plinlimmon. That fish was merely a trout whose vertebræ were not all right, and therefore gave him a deformed appearance. I believe that the diseased vertebræ were due to the unhealthy surroundings of the stream, to pollution. It was of the same nature as "phossy jaw."

If in a stream where there used to be good fishing and healthy fish, the fish are still there, but have fallen off in quality and appear to be wholly out of condition and sick, it is most probable that the reason is there is some pollution going on. It must be remembered that there can be very serious pollution without discolouration, and water that looks perfectly bright and pure may yet be very deadly. On the other hand it does not always follow that discoloured water, or water highly charged with substance in suspension, is injurious. It wholly depends on what is the cause of the discolouration, and what are the matters in suspension. If the water is discoloured it is always necessary to be on the look-out for danger, but absence of colour by no means implies immunity from danger. Indeed, if a stream is going wrong, and there is no cause that can be found for it doing so, the chances are it is some form of pollution, and this should be always looked for.

The injury to the food is one that is very real and is not often noticed. It usually follows not from a casual but from a continuous pollution, and is of two kinds: if the pollution is in solution, everything is poisoned; the river seems as bright as ever and looks all right, but the water is so highly charged with some mineral poison that all life has perished. This was the case with the Upper Severn, when the lead mines were in full work. Above the mouth of the brook which came from the chief mine there were fish in abundance, below there was not for some distance a living thing,—not only no fish, but no water insects. On some streams it was worse: not only were the fish and all forms of life in the stream killed, but the ducks that took the water, or the cattle that drank it, and even in some cases the vegetation on the banks, were affected. Attempts were made to restock some of the streams with fish, but they failed from the fact that the fish when put into them were starved. A total destruction like the above is fortunately not common, but a partial destruction is a very common form of injury. The polluting matter destroys, or rather prevents, the growth of the plants, and drives away the water insects, and so reduces the food, or it injures the eggs and larvæ of the insects and so causes a decrease in number. There is a further injury, the effluent that is discharged from some of the sewage works is said with pride by the authorities and the Local Government Board to be a sterilised effluent, so that while it kills nothing it nourishes nothing. And by absorbing the oxygen in the water would, if it did not absolutely injure, at all events not benefit the fish. Bad as the old sewers were in various ways, they yet brought down a certain amount of food, both for fish and for the water insects. A great deal of the liquid that was deleterious was lost by the leaky sewers, and the solids that remained either furnished food for the fish or for the insects on which the fish feed. For all these a sterilised effluent is substituted that not only gives no food to any of the water organisms, but very likely serves to deprive them of what food they have. Starving the insects means less production—that is, less food. So that the operation of pollution is first to kill fish; secondly, to create unhealthy fish; and thirdly, to affect and reduce the food supply.

Beyond all this, and what is the supplement of all, is the injury pollution does to the river. In many rivers the beds of the streams are spoilt by deposits caused from manufactories and from towns. The deposit is not by any means always in itself deleterious: it is often quite harmless, but it does very great injury. Take, for instance, the silt off roads. Roads are far better repaired than they used to be, more metalled and generally better; but the result is that a storm of rain which used to lie on the roads now runs off at once, carrying a lot of silt into a river; the silt deposits on the first shallow, and that soon becomes a bank that for fish-breeding purposes or for producing fish food is useless. Every day the beds of our rivers and brooks are being more and more choked up by this cause, and ground which used to be available either for breeding fish or breeding food becomes available for neither; that is, the productive area of the river is yearly diminishing. So again in the case of town refuse carted to the side of a river, every storm washes some of it in and creates a source of pollution. The gradual silting up of the beds of streams is now generally admitted; but all such silting up lessens the area of the river that is available for fish, and the reduced area means that the places adapted for fish must become more and more crowded, so that the number of fish must decrease. This view of the pollution of rivers is not generally regarded, but it is becoming a very serious one from a fishery standpoint, especially when taken in conjunction with the abstraction of water from the river.

Curiously enough the fish suffer from the measures that are taken to obviate the effect of silting up. Authorities see the importance of keeping the river clean, and so dredge out and clear out the shoals, not only those that are silted up, but others as well; and here again this is bad for the fish. The disappearance of the shoals and giving the rivers a uniform depth have led very much to the disappearance of the *Salmonidæ*, as their opportunities for breeding are taken away. Hitherto the coarse fish have not felt the alteration in our rivers, rather it has been in their favour; but the system of dredging will probably in time affect even the coarse fish. It certainly will diminish the food supply; for every shoal that is dredged out means so much less food produced, so much less to be eaten. It will thus be seen how serious the pollution question is for our rivers. It is not merely the discharge of poisonous liquids, killing a few fish on particular occasions, that has to be feared; it is the gradual destruction of the rivers, by rendering them so unwholesome that neither fish nor the food of fish can live in them, and by so changing their character as to render the production of fish and of fish food much more difficult; and yet for all this there seems no remedy. For whenever any legislation is attempted, as in the Floods Bill or the Pollution of Rivers Bill, it would appear that the framers of those measures are ignorant that there are any fisheries, or even that our rivers contain fish, and try to increase the evil.

It is difficult to say what can be done as the law now stands in the matter of pollution by either Fishery Boards or fishery owners. All that can be suggested is to keep a constant look-out for pollution, examine all dead fish and endeavour to acquire full knowledge of the appearance of fish after all forms of poisoning, so as to be able at once to detect if anything is going wrong. It is impossible to be too careful. Pollutions occur in the most unexpected way and from the most unexpected sources. A water bailiff should be always on the look-out for them. But for the worst kinds of pollution—the injury to the food supply, the injury to the river itself—all that can be done is to get together all the information, so as to make such a case as will either induce Parliament to interfere, or as will enable measures dealing either with the pollution or the conservancy of rivers, to be so framed that, if they do not benefit, they shall at least not cause additional injury to the fisheries. But if this is to be done it can only be brought about by the united action of the Fishery Boards and the fishery owners, for the Local Government Board and the Board of Trade in such matters are worse than useless; they are afraid to act, as their action would make them unpopular and discredit their present procedure.

CHAPTER IX

ABSTRACTION OF WATER

WITHIN the last twenty-five years a new and very serious danger has arisen to our rivers, and one which threatens to have far wider reaching results than are now even suspected—the wholesale abstraction of water from the head waters of our streams. The process is to cut off so much of the gathering ground at the head of the river as some Corporation thinks will meet its needs, to collect all the water that falls on it into a large reservoir, only allowing a certain fixed quantity, known as compensation water, to flow from the reservoir into the river. Instead of the old supply, all the rest of the water is taken away to some place outside the watershed. It is quite true that the promoters of these schemes allege that what they do is for the advantage of the district, that they get rid of floods, and give a fixed instead of a varying quantity of water to the river; but, after taking all these so-called advantages into account, there can be no doubt that these water abstractions do most serious injury to the river, injury which is in no way met or obviated by the compensation water usually given. Fishery owners and Fishery Boards have so far failed to realise or understand the real effect that cutting off an important tributary has upon the economy of the river. They have been led astray by the specious argument that the river must be better off than it was, because the river will always receive, even in the driest summer, twice the minimum flow for the average of three consecutive dry years. Or, as it is sometimes more speciously put, a very small portion of a district is taken, where the whole watershed is so many hundred square miles; over this there is a total rainfall of so much, and as it is but the smallest corner of the district that is being taken, it is only an infinitesimal portion of the rainfall that is being abstracted. The first answer to this is that the rainfall is not the same over the whole watershed, that the part taken for the waterworks is always that of the highest rainfall.

Corporations pretend to show that a water scheme really benefits a river, instead of doing it vital injury. Not only is this line of argument based on a fallacy, but so also is the mode in which the Corporation offer to give what they call adequate compensation. They have induced Parliament, in fixing the compensation to be given for taking away water from a river, to proceed on the line—that giving a certain quantity of compensation water, a quantity that is wholly inadequate, together with a sum of money as a fund to be used for improving the fisheries, is generous treatment; and Fishery Boards and fishery owners have acquiesced in this principle, only quarrelling as to the quantity of water and the sum of money. If all the items on which compensation should be paid were taken into account in fixing these amounts, this might be a way of settling the matter, as it is an obvious and easy way of arranging a very difficult question; but in no case that has yet occurred have either the water or the money been sufficient to compensate for *all* the damage done, the reason being not that Parliament is indisposed to deal generously with the river, but that those interested in the fisheries have brought forward one ground alone for compensation, instead of the various heads of damage which they will suffer. The case for compensation has been exclusively based on the injury done to the river by adding to the difficulties the migratory *Salmonidæ* will experience in travelling to the upper reaches to breed. Everything else has been left out of sight. The passage of the fish up stream is a most important item, but it is only one item out of many for which compensation should be given; so far it has been the only one compensated, nothing has been given to fishery owners in respect of fish, unless the river is a salmon or migratory trout stream. No Corporation has as yet had the assurance to assert that compensation is confined to migratory fish; but this is the result of what they have done, and of the principles on which they have persuaded Parliament to act. There are, however, other points upon which the persons abstracting the water from the river should be made to pay compensation; as to these, so far as I am aware, not only has compensation never been awarded, but no claim has ever been formulated. They vary in value on different rivers; for each river has its own special points that require consideration. But in every case all the different points should be considered, and proper compensation given for each.

The principle on which compensation should proceed is not merely the injury done to migratory fish, but how far does the proposed change from the natural condition of things injuriously affect the river as a whole; and the compensation should be based upon the whole of the injurious effects of the change. The question, therefore, is, how will the change affect the river?

It will be admitted by all that any interference with a river, such as the abstraction of a large quantity of its water, must alter the natural condition of the river; and all who have had any experience of fishery management, except possibly water engineers, will agree that the natural condition of the river is the best for the fish, that any interference with it should, in their interest, if possible, be avoided. The starting point is, therefore, that those who interfere with the river are about to act to the prejudice of the river. The injury may be infinitesimal, or it may be serious, but it is injury which the promoters have to make good. It may also happen that although in itself the interference may be trifling, and if the river were in a natural state would not require much notice, yet some previous interference with the river may have so altered the natural condition of things that even a very slight further alteration may in the particular case be most injurious,—in effect be the last straw.

For instance, to a highly polluted river, the abstraction of some million gallons of pure water would be serious; while, if the river was unpolluted, it might hardly affect it. Or again, the substitution of a fixed for a variable flow might, and very often does, totally alter the character of the river by converting its low, summer dry weather state into its normal state, and so reducing it to a much smaller stream than it formerly was. It is one thing to have a large stream reduced to a very small channel for six weeks or two months out of the year, and quite another to have it permanently reduced to the small channel.

These two points are the first to consider,—the change the works will produce in the character of the stream, and in its volume. The character may be changed from being a series of pools and fords into nothing but one or two long pools, with a trickle between them up which fish cannot pass. This may be endurable for the summer months, but not as a permanent state of things. Yet this is what a permanent compensation of twice the average flow for three consecutive dry years means —a perpetual change in the character of the stream.

What the effect of the change will be is never considered; but even the Corporation, if they know anything about fish, will hardly suggest it to be an improvement to reduce for ever the area of the river and to crowd the fish into close quarters. The state of things a dry summer brings about in the upper reaches of a trout stream are always such as to cause the owner of the river great anxiety; the fish are crowded into the pools, are easily poached, and are usually half-starved, as the food that the pools produce is not enough for all, and the food that comes down the stream is practically nil. A dry summer usually means a bad spawning season, as the fish, being ill fed, either do not spawn till late or do not spawn at all. As dry summers are not universal, the evil only occurs at intervals, but the Corporations propose to make it the ordinary state of things, and, like the Lady in the Book of Proverbs, say that they do no evil. The change in the character of the stream is of itself a question of most vital importance to all the fisheries of whatever kind all the way down the stream, but it is never even considered; the reason being that it is not for the promoters to suggest it, and Fishery Boards and fishery owners have not and will not take the trouble to obtain the evidence necessary to support their claim for compensation. They have not the facts upon which such a claim should be based, and such facts, as distinguished from pious opinions, take both time and trouble to collect.

Some of such facts would be the following:—

1. A careful statement, extending over as many years as possible, showing the winter height of the river, the summer height of the river, the ordinary height of the stream, and the effect those variations of height have on the river; the lowest state of the stream should also be shown, and what is twice the lowest state. If the fords that are useless in low water are marked, and the quantity of low water calculated, it is quite possible to prove to demonstration what the real meaning of compensation water on the stream is, and to show how the character of the stream will be changed. A series of photographs of one good ford in the ordinary height of the river at low water, and at the average annual height for three consecutive dry years, will do more to demonstrate what the Corporations propose to do than any amount of expert evidence.

If an assumption is made, a favourable one for the promoters, that the stream *may* be kept to its average summer level, an exhaustive series of observations to show what is the meaning of such an expression as to the stream, should be prepared. It will be found, as a rough rule, that the summer height of a stream means the reduction of its size to at least half, that is, that half the area now available for producing fish or producing food will be done away with; and if the stream can at best only produce one half of what it did, the extent of the injury will be grasped. It may therefore be put in this way, that the stream, the upper waters of which are taken, will certainly lose the area taken, which will have to be paid for; next the rest of the stream will be injured, by not even under the most favourable circumstances having a productive capacity equal to more than one half what it had before the works were made. The loss may, however, very often be much more than half; this will depend on whether the compensation water is the sole or the main source of supply to the stream. If it is the chief source, and there are no considerable sources of supply from springs, or streams below where the dam for the reservoir is made, the river may be regarded as almost valueless. If the compensation water is discharged at a high pressure, and to ensure it at all times it is necessary it should be so, what appears a very large quantity can be sent through a very small aperture. Ten million gallons in a day of 24 hours, although this quantity looks something enormous on paper, can be sent down a 10-inch drain pipe if there is sufficient pressure. If a section of the river is taken showing what is its width, what quantity of water is required to maintain it during the 24 hours at 4 inches in depth over the present channel, and how much of that channel will be covered by the flow through a 10-inch pipe, the value of compensation water and the amount of change that will be brought about by the works will begin to dawn on the fishery proprietor, and he will at length see what case he has to prove. Nor does the change end here. The water being discharged at a high pressure will form a channel for itself, and the channel will gradually become the only channel of the stream; the rest will silt up and become useless, and year by year the available area for the fish will become less. True, the deep pools will remain; but the deep pools will not keep the river going without the fords, and the fords will yearly become less. The character of the stream will be permanently changed, and changed for the worse.

A water engineer will calculate at once the difference that will be caused to a stream by the discharge of quantities varying from 200,000,000 gallons in the 24 hours to 3,000,000, where the discharge is spread over a line forming the width of the stream, and a permanent discharge of 10,000,000 gallons each 24 hours through a 10-inch pipe; and will admit that the character of the stream will be entirely changed by it. He will doubtless say it is improved—that is a matter of opinion; but he cannot deny that the area of the water way will be reduced considerably, and the nature of the stream entirely altered. The reduction of the area of the water way means a diminution of the productive power of the stream, both as to fish and as to food; and it may be the injury is mainly confined to the particular stream, although this is by no means always the case, as the stream may have been either understocked with fish, and so supplied food to the other streams, or have been so good a food-producing area, that although fully stocked with fish, there was always food over and above what it required that went into the main river. The injury which has to be compensated for is twofold: to the owner of the stream, by having the productive power of the stream reduced so that it cannot be of the same value as before; to the river as a whole, by having one of its sources of fish and food supply cut off either wholly or in part. The amount of compensation to be paid depends on the value of the fishery to the proprietor and to the district—that will depend on the particulars of each case; but when the effect of the work is considered, it will be found that both owner and district have suffered loss, whatever it may be, for which they should be compensated. It must also be borne in mind that this question, as it has been now stated, has nothing to do with migratory *Salmonidæ*—that is a wholly different ground of injury. So far the damage that has been considered is confined to the alteration of the character of the stream, occasioned by causing its source of supply to be a fixed quantity of water delivered every 24 hours under high pressure over a fixed part of the stream, instead of a variable quantity delivered naturally over the whole area of the stream.

It is often said by promoters that the quantity of compensation water given satisfies the mill owners, and so the fishery owners have no reason to complain; if the water is enough for the mills, it must be enough for the fish. This idea, however, is based on entirely erroneous considerations. The conditions required for mills and for fisheries are totally different, and, to some degree, antagonistic. The mill owner wants a certain quantity of water to turn his mill. He knows, or should know, the precise quantity; give him that, and he is satisfied. Variations in quantity are an evil to him; they entail uneven working and breakage of machinery, delay, and loss. What he prays for is a uniform quantity that he can always rely upon in summer or winter, whether the weather is dry or wet. This is what compensation water gives him; it just meets his case. He is able to say exactly what his output will be, for he knows when he has secured a uniform supply of water how much his stones or his rollers will turn out in the 24 hours, and how many hours he can work. To the miller a flood is a visitation of the evil one. It means loss of time, loss of money and damage to machinery. To the fisheries a flood is a necessity. The miller desires uniformity; he gets it. The fisheries require variation; they are deprived of it. There would be difficulty in finding two more conflicting interests.

The question of the effect of the change produced by the alteration of the volume of the stream probably affects the district as a whole more than the stream itself. The quality of the water in the stream is not altered; perhaps it is improved, as the promoters are bound to see that the water in their reservoir is free from pollution, and the fishery owners may be fairly confident that the water discharged into the stream is pure. There is probably a difference in the temperature of the stream caused by its water supply being drawn from a great depth, instead of running into it off the surface in shallow rills; but this is a minor matter. The important effect on the stream would be, that it would never, or if ever, only on exceptional occasions, be scoured out, as it is now, by autumn and winter floods. Sufficient importance is not attached to the beneficial results of these scourings on the condition of the river. The removal of all the filth that has accumulated on the bed of the river, the cleaning out of the shoals before the fish come on them to spawn, are the natural means for keeping the river healthy, and getting rid of them must affect the river. There are no data that I know of to show whether, if fish breed on shoals that have not undergone their natural purification, the results are not so satisfactory as if they had; but it must be so.

Any interference with nature produces unexpected results; and it will be a curious question to see what will be the results on fish life of doing away with one of the natural safeguards for securing a healthy place for breeding.

It is more easy to speak positively on another result of the absence of scour,—silting up. One of the great uses of floods, or rather of freshets, is to keep the bed of the river clean, and to carry away all the summer accumulations in the channel. This the stream will lose; the promoters boast that it will be so; and some of them have the impudence, I can use no other word, to put forward the view that they are really doing good to the fisheries, as by giving a fixed quantity of water and preventing sudden rises, they do away with the washing of the gravel and the loss of ova.

That this is no imaginary case will be seen from the following extract from the Report for 1898 of the Engineer to the Severn Commission of the effect of Liverpool Corporation works which have now been in use for ten years, on the Severn. It must be remembered that the compensation from them is not only a daily one of 13,000,000 gallons, but an additional one for three days each month from March to September.

"Deposits of tidal mud accumulating in the channel of the river for a few miles above Gloucester in quantities too large to be dealt with by the dredgers, have for some time been a source of considerable anxiety as likely to become an obstruction to traffic if unchecked; but I am pleased to say that recent experiments have shown that systematic scouring with a powerful eroder during freshets and high tides will always be able to effectually deal with the difficulty at moderate cost. I find that after making full allowance for a smaller rainfall, the strength and frequency of the freshets which formerly had so useful an influence in removing this tidal mud, have been seriously reduced since impounding the water commenced at Lake Vyrnwy, and I am afraid the difficulty is one which will always have to be provided for whenever a dry cycle like that of the past six years shall occur."

That is, at the distance of over 100 miles the effect of the works on the river is to cause deposits of mud; when the fish try to ascend the river, they are met with the water containing the suspended deposit under the influence of a powerful eroder, and it is asked why do so few fish run up? Mr. Marten, in a fine vein of sarcasm, adds:—

"The daily and monthly compensation water has been regularly and properly discharged from the Vyrnwy Reservoir of the Liverpool Corporation in accordance with the requirements of Parliament!"

The loss of volume is, however, more seriously felt in the main river than in the tributary streams. Most of the tributaries of our salmon rivers have a considerable fall in their level into the main river and discharge their water at some velocity; of this discharge the main stream will be deprived, and of all its scouring power there will be a trickle, and nothing more, instead of a cleaning scour. The injury to spawning beds is, therefore, twofold: (1) a great deal of the ground which is now used for spawning will be no longer capable of being used, as it will be dry; and (2) what remains available will never be really fit for the purpose, never be cleansed or purified, and will be more or less covered by silt. That this will affect the river there can be no doubt. No one who has had any experience with breeding *Salmonidæ* but will affirm that one of the first essentials and one of the most important is to have clean washed gravel. If the gravel is full of impurities, it is fatal to hatching out a good percentage of ova.

There is a further ground by which the reduction of volume of a tributary will injure the river. At present, most of our rivers are polluted, and in many it is a question whether the fish can hold their own much longer. It is said (it would be more satisfactory if it were true),—that the number of pollutions is not increasing, that the Local Government Board, County Councils, and Sanitary Inspectors, are preventing that. It is to be hoped that is so; but so far as fish go, pollution can be increased in two ways, not merely by adding to the number but by adding to the intensity. If a large quantity of pure water, which so far diluted the pollution as to make it bearable, is taken away, the river in effect becomes more polluted than before; it is more deadly to fish, and far more mischievous, from the cleansing process of the pure water being done away with; there is nothing to mitigate the intensity of the pollution,—nothing to keep the bed and shoals of the river clean. In short, the river becomes an unflushed sewer.

The effects of the waterworks on the river have so far been considered quite irrespective of the migratory *Salmonidæ*. The alterations made by the works in the character and volume of the river, Any interference with nature produces unexpected results; and it will be a curious question to see what will be the results on fish life of doing away with one of the natural safeguards for securing a healthy place for breeding.

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[illegible]

[illegible] channe[illegible] [illegible] considerable [illegible] sediment [illegible] systematic [illegible] freshet [illegible] effectual [illegible] a smaller [illegible] the freshet [illegible] fluence [illegible] serious [illegible] commencing [illegible] difficult [illegible] past six years [illegible]

That [illegible] effect of the [illegible] of much [illegible] are met [illegible] deposit under [illegible] and it is [illegible] Marter [illegible] have been shown to do damage to the fisheries of whatever kind they may be, damage to the individual owner, damage to whole districts; and these alterations seem to be such an injurious affecting of the stream as to entitle the owner and the Board to compensation on these grounds, apart from any other. Both owner and Board would have to prove their case, and to show that the injuries suggested actually do exist; but with a little care, time, and trouble, this is not difficult to do. But it is impossible to do this if Boards and fishery owners only begin to get up their evidence, as they usually do, either after the Bill for the works has been deposited, or even after their petition against it has been presented. To establish such a case as indicated requires time, trouble, and some expenditure of money; and it is a matter for owners and Boards who are threatened, as many are now (for instance, by the London scheme to take water from Wales), to consider if it is, or is not, worth their while to procure the evidence necessary to support their case. One thing they may be sure of, if they do not; they will get no compensation. The matter is one that has to be proved by facts, not decided by expert evidence.

As to migratory *Salmonidæ*, while the same considerations that have been already stated apply to them as well as to other fish, there are also matters that apply to them alone.

The first question is, how far does the reservoir affect the summer floods or freshets? That depends on the size of the tributary taken; if a large one, it may affect it greatly; if a small one, only indirectly. It also depends on the question of rainfall. If, as is often the case, the tributary taken is the one on which the rainfall is the highest, the chances of summer freshets are decreased. It may be said that summer freshets are not essential to the existence of *Salmonidæ*, and that is to some extent true; but they are essential to their distribution, and if any fresh-run salmon are ever to reach the upper waters of a river, summer freshets are essential for the purpose. Modern farming and drainage have done much to abolish them by causing the water to run off at once, and so only to cause a temporary rise of a few hours, and not a freshet. If the main source of supply that can be looked to for causing and maintaining a rise in the stream is cut off, as it is by the reservoir, all hope of a freshet is gone. For the other streams by themselves may not be enough to raise the river, and, if they are, the freshets will cease when the water of the wettest district—which kept the stream up to the height to which the water from the other streams had raised it and prevented it running off in a few hours—is taken away. The whole question of a weekly close time and its value depends on freshets ; if there are none, a weekly close time is a delusion so far as getting up the fish is concerned, and the question will require very careful consideration whether weekly close time should be retained, now the reasons for it have been done away with. But even if the reservoir does not entirely do away with the freshet, it may well prevent it being of the smallest use. In many of our weirs and passes the difference of a couple of inches in the height of a freshet makes all the difference whether a salmon can or cannot get up. It will be admitted that the effect of the reservoir is to reduce the height of the freshets : this the promoters put forward as one of the advantages of the scheme. This may really mean that it prevents the salmon passing up, and so renders the freshet valueless.

But the freshets are not only important in bringing up the fish, they are important in taking them down. Every one connected with salmon fisheries is desirous of freshets in March, April, and May, for two reasons,—to get rid of the salmon that have spawned and which are lying in the pools, either feeding on the smolts and trout, and so doing mischief, or with more or less disease on them, thus making an outbreak by no means improbable. Get rid of kelts even if you have to kipper them, is a sound principle in salmon preservation, and the first fresh does this for you. If, however, the fresh is not enough to take the fish over the weirs, they lie at the back of the weirs doing harm, and are the centre of disease. The extra water that the reservoir intercepts, if it would not have made a freshet of itself, which it probably would have done, would at least have made such a one as would have cleared the river of the kelts. Here again, a great injury is done to the river; which is not taken into account in fixing compensation, as Parliament has considered only the ascending, not the descending fish.

But the kelts are not the only fish that require spring freshets; there are also the smolts. If the river is to keep up its stock of fish, it is vital to get the smolts to sea at the earliest possible moment, and the great bulk of smolts will only descend in a fresh; as long as they remain in the fresh water they are exposed to all kinds of danger,—pike, kelts, anglers,—the last often the worst. The sooner they get to the sea, the sooner they will return as grilse. They will not go without a freshet. If either there is no freshet or only a very slight one, the smolts are not got out of the river, and if they stay, numbers are lost. Anything that reduces the number, the duration, and the height of the spring freshets injures the smolts, and thereby the stock of salmon in the river. Therefore, the waterworks injuriously affect the migratory *Salmonidæ* and so the district. By doing what the promoters claim as one of the great advantages, reducing or getting rid of the spring and summer freshets, they alter the distribution of fish and they prevent the fish reaching the sea at the proper time. This again is an injury affecting the river for which compensation should be made, and which at present is not taken into account.

There remains the case of the ascending fish. This Parliament has recognised as a subject for which the promoters of waterworks are bound to pay compensation. But the compensation has been based on much too narrow grounds. The injury done to the river by the waterworks is not to be cured by the erection of a fish pass or two, which is usually considered all that is necessary. The abstraction of the water may have rendered, not only the stream from which it was taken, but also the river for some distance down, quite unsuitable for salmon breeding. The injury depends on the change that has been made in the character of the stream dealt with and the other streams it affects. To count the beds in the stream and to say only so many fish spawned—the injury is only so much—is not the way to arrive at it. The question is, has the character of the stream or streams been so altered as to render them less productive and less capable of being made productive? It may well be that the stream is so altered in its nature that it will be far better to keep the salmon out of it entirely; for instance, the reduction in area may mean such facilities for poaching as to make it impossible to protect it at a reasonable cost. The abstraction of the water may have rendered the river for a long distance below the mouth of the tributary quite worthless, as there is no longer sufficient water to cover the best beds and no longer sufficient stream flows over them when it does come. Or it may have left dry all the best salmon spawning ground, composed of large gravel, and only kept its course over what was fit for trout. All these points will have to be taken into account in each case, and in proving the claim for compensation it should not be merely that a stream with a certain number of beds has been lost to the river, but how far has the general economy of the river been affected. It will be found on examination, that the works have injuriously affected far more than was at first imagined.

As to the ascending fish; the effect of the waterworks on them may well be to make the ascent far more difficult by affecting all the fish passes on the river. Most of the fish passes are so constructed that salmon can only really use them at certain states of the water—not at all states. The alteration in the volume of water in the river may, and very probably will, so alter the condition of the different fish passes as to make them less efficient than they are at present, for it is usually found that it is more from a want than from an excess of water that passes are not efficient, and the days when there will be plenty of water will be decreased. But even if this can be got over, there still remains this point, that when the salmon do get to the upper reaches of the river, the places are in a worse state for them than they used to be, the existing conditions have been altered for the worse,—the river is less adapted for *Salmonidæ.*

There is a further point: the injury done by the waterworks is not at first apparent,—it is one that goes on increasing year by year as the conditions that are brought about by the change produce their effect on the river. At first there may be but little difference noticed. A series of wet years or something else may occur that will prevent the full effect of the works being felt. But year after year the change will be more and more felt, the river will be more silted up, the bed of the stream become fouler, the fish will gradually get fewer and fewer, the river will be less capable of sustaining them, and very likely become so foul that the fish will not face it. Yet there will be no compensation payable, for that is fixed once and for all, and before the true effect of the change has become known. It is therefore imperative on all those Fishery Boards fishery owners, and fishery occupiers who find their lot cast upon a watershed on which a Corporation has designs of using it for a water supply, to obtain all the information they can as to the injury the works may cause them, and to take steps to be able to prove by evidence what their present position is, and how it will be changed or injured if the proposed works are carried out. Injured they will be; compensated they ought to be; but whether they will be adequately compensated or compensated at all depends very much on themselves.

CHAPTER X

MANAGEMENT

HAVING said so much on the necessity for good and systematic management of fisheries, and having spoken so strongly on the want of it that now exists, it is only right to point out the principles on which it is suggested fishery management should be carried on. I do so with great diffidence; for, while I am far from certain if any one will agree with me in the principles I advocate, I am quite certain most persons will disagree with me in the way they should be carried out. It has been said that every Englishman believes he understands theology by nature. I have never yet met the subject of the Queen who would admit that he did not know everything about fish. My view is that a fishery is a business matter, to be managed on business principles, like any other business; that there is no particular magic in it; all that has to be done is to learn the work, and, having learned it, to apply ordinary business principles to its conduct; to treat a fishery as you would treat a farm. Probably neither will pay; but both can only be expected to pay if they are managed on some system. The first thing to do is to find out, and find out for yourself, what it is you have to deal with. As you would go over your farm, so you must go over your fishery, and ascertain by using your own eyes what you have got to work upon. Do not bother about the fish until you have made yourself acquainted with the details of the river you have to manage, for, until you know those, it is waste of time to think about anything else. There are two rules which, if you follow them out strictly, will save you from enduring much annoyance and using much bad language.

1. Never deal with a very limited area of river.

2. Never deal with one side only. Whatever may be the extent you have, have the whole or none.

You will find that even if you are an angel from heaven, the person who is just above you, and the person who is just below you on a river, while they may possibly regard you as an angel, will not agree with you as to your place of origin, and their ideas and yours are sure to clash, and so cause trouble. My experience of owning one side of a river is that it means, in plain English, providing fish for the other side to poach. Get, if possible, not less than a mile on both banks, and as much more as you can. Get also as high up the stream as you can; there is less danger of pollution; you are quieter, and the rain does you far more good than if you are lower down. Having got your water, think carefully over what fish you will have. That depends on the river, whether it is a salmon stream or not; and whether you intend to encourage coarse fish or to discourage them. Before deciding, make yourself acquainted with the character and contents of the river. I have already given some rough hints how this is to be done. But you cannot take stock in a river as you can on a farm; you cannot reason that because in one pool you have so many fish, if you have two pools you have twice as many. All you can do is to note down what fish you *see* in particular pools or in particular fords. I say what you see, for if you do not verify everything with your own eyes, you will go wrong. There is an inveracity connected with fish upon which it is always safe to rely.

It will depend on the water, the weather, the extent of the fishery, and yourself, as to how long you are in getting a knowledge of what fish there are in the stream. It is a subject on which you must trust nobody, believe nobody, tell nobody, not even the wife of your bosom ; but listen carefully to what she or any one else tells you. In about a fortnight, if you work hard and if the conditions are favourable, you ought to get some idea as to how far you have been cheated in the acquisition of your fishery. Having formed your own views proceed to test them. Propose to some local loafer to net out one or more of the pools. From his offer to help and from the way he goes to work, and from the remarks of himself and his friends, you will get a very good idea if they are or are not practically acquainted with netting the river. Do not expect to catch much, you will most likely only tear your nets. Netting in fresh water is an art that requires long learning if it is to be practised with success, and the number of amateurs who are masters of the art are very few. You will, however, learn several things in trying it,—first, whether the place has been recently netted ; if the net comes very smoothly without fouling, you may be fairly certain it has been. Next, if your neighbours are in the habit of netting, this will be shown by the way they select the landing place and work the net; and thirdly, if the place has not been much netted, or even if you do not catch any fish, you will learn whether there are many fish in the place. And if you determine to prevent netting for the future you will get some idea where best to place your stakes. You will also get some idea as to the best form of net to use—a draft net or a trammel.

It would be well to go over most of the water with the net, noting carefully all that you see at each place. If you use a draft net have a good look at the stuff the bottom line brings out. You will see a collection from the bed of the river, which should teach you a good deal—first as to the food, next as to what fish have bred; don't be above taking the small fish, putting them in spirits and examining them at leisure. They will show you what fish are breeding and where they breed. A comparison of what comes out at different drafts is most instructive, as it gives a rough idea as to whether or not some of the pools contain more food than others, and whether some of the places are those where the coarse fish breed. Having got this done, and if necessary repeated, you will be able to put down in a book your rough ideas as to what there is in the river. Having done so take any opportunity of testing them. Do not attempt to say what the numbers are, it will only lead you into error,—something like "very few," "few," "moderate," "abundant," will be quite enough to begin with. This should be made up from the list of the fish caught at each draft, an accurate record of which should be kept. You will probably have been able to arrive at a conclusion as to the comparative number of trout and coarse fish, and upon that you will have to decide. Are things to go on as now? Are the trout to decrease and the coarse fish to increase, or, are the trout to be encouraged? The decision on this point will influence much of your future procedure. It may be said at once it is much easier and involves much less trouble to have coarse fish than trout. The netting will have helped to determine another question of importance, namely, the comparative size of the fish in the water. This is necessary to know in considering the question as to whether the river is over or under stocked. If there are very few or no medium sized fish, if there are only large and small ones, yoú may conclude with safety the river is over stocked, having regard to the existing food supply. But if you get fish of all sizes—large, medium, and small—you may conclude that the stock of fish does not exceed what the present food supply can maintain. If you are in doubt, it is as well to assume you are over stocked, rather than under. You have now the facts before you which will enable you to decide what course you intend to follow; and you have to answer two questions—

(1) Am I going to preserve trout?

(2) Have I got enough fish in the river?

If you determine not to preserve trout, and that you are not over stocked, you will do nothing more but leave things alone; stop all fishing; allow no one, not your most intimate friend to fish, do all the fishing yourself, and make your keeper do all the work and keep all persons off the water. Never mind what is the alleged pretext, let no one fish but yourself. You want to acquire a good knowledge of the river, and this is impossible to do if persons are always going up and down and scaring the fish. You will find it hard work using all precautions; you will find it impossible if you allow every oaf in the parish to wander about and scare the fish. I do not say you will be popular in the neighbourhood, but you have undertaken to manage a fishery, not to court popularity, and the two are not quite the same thing.

If you settle you are going to preserve trout, and the trout do not considerably outnumber the coarse fish your next step is to get out some of the coarse fish, and you have to decide which. *Prima facie*, I should take out chub, pike, and ruff. The number to be taken out depends on two things, —the number of your trout, and the number you can catch. It is all very well to say take out pike, but it is not easy to catch them. However, it is to be done; and no means, net, trimmer, shooting, spearing, or snaring should be spared. Get them out with a rod and line if you can, but get them out. The same with chub; one device for these may be mentioned; it is poaching, but useful; when you have put a net through a pool, and, as is often the case, caught nothing, go either in a boat, or, if you can, walk round the pool and feel under the bank, and you will after a little practice secure many a chub. The quantity to be taken out depends on your stock; but the best rule is, it is better to overdo it than underdo it. If in the course of your operations you get hold of any large trout, say 2 lbs. and upwards, kill them as you would a pike, never spare them.

Having got out what you can, the next question is, what is to be put in to supply their place if you are not over stocked. Assuming you are about to lay down trout, a rule that should always be acted upon is, lay down yearlings. It is true they are expensive, but you get far more for your money, and they are cheaper in the end. If you turn in fry by the canful, it is only in American official reports that the effects are very appreciable. But 1,000 yearlings are almost sure to bear some results. Some few—it is usually only a few—are caught, but it is often fairly clear that they have bred and done some good. From fry the same results are hardly ever obtained. If you buy yearlings go early and select them yourself; do not take what is offered you, and do not buy after every one else has had the pick of the lot. There are yearlings and yearlings, and it is almost impossible to make a greater mistake than to pay the full price for the leavings of every other buyer. This, however, is the result of what often occurs—a sudden determination to buy a certain number of fish to turn down. Having bought your fish, do not turn them down until you are ready for them: as no one who knows anything about planting would plant a tree if he wanted it to grow, before he had prepared the ground properly, so do not turn down your yearlings until you have got a place or places ready for them. Fix on the pools into which you will place them, pools with some shelter, and communicating with nice fords, where the fish will be able to get out and feed, but where they can at once regain shelter. When you have fixed on your pools, begin to net them, and go on netting day after day. It is not for what you will catch, for probably you will catch nothing; but it is because continued netting will drive all the old trout and the coarse fish out of the pools; so your yearlings will have a chance at starting. If netting does not succeed, there is a remedy that should be used only in a last resort: if all else fail to clear your pool, use it, but do not talk about it. It is illegal to use dynamite to catch or destroy fish and the penalty is £20; but it is not illegal to use dynamite to remove obstructions from your fishery, which either spoil your draft or prevent your doing what you want to do to the trout. Find some improvement to the bank or pool that requires the use of the explosive, and use it just before your yearlings come; you will have carried out your improvement, and you will have cleared the place for your yearlings. Your purpose will be as well served by an explosion to get rid of a stump as by an explosion to kill fish. Dynamite has another use: it enables you to form a better opinion than you otherwise would of what fish there are in the pool. Netting is fallacious, as the fish soon learn to dodge the net, but dynamite shows you fairly what is in the pool. I do not say everything is killed by the shock, but a very large percentage is. A careful note of the result, so far as fish go, of removing an old willow tree from your water is a most valuable guide to the accuracy or inaccuracy of your previous calculations. It must, however, be remembered that such a heroic remedy can only be used very occasionally.

You are now in a position to form some idea of your work. You have your estimate of your stock of fish, which you have taken all means in your power to test, and should be able to say if it is or is not fairly accurate. You have taken out so many fish and recorded the number, and you have put in so many. You have now to wait and see the result of your work. All through the next year you should keep as accurate a record as you can of all fish caught by every means, rod and line or net, and at the year's end you will again take stock and see what has been the result. Has your total stock of fish increased? Can you see more fish than you did,—more fish feeding, more fish spawning, more fish basking, or do you see fewer? If you see more, are there more coarse fish, or more trout, are there more trout in the parts where you tried to work out the coarse fish? If there are, then what you have done is a success; if the trout are about the same, then you have only done enough to keep up an equilibrium; if the trout are fewer, then there is something wrong in your work besides the coarse fish; and before you go to greater expense, you have to find out what it is. It may be pollution, but if it is, you ought to have found some dead fish; it may be lack of food. But something there is, and it has to be found out. It would be idle to conjecture; a knowledge of the local circumstances and a close observation of facts will alone give you some clue. You must follow up the smallest indication with an ingenuity as great, or, if possible, greater than is recorded in the detective details of the wildest shilling shocker. One instance will show what I mean. On a small trout stream an owner used to hatch and turn in every year a large number of trout. His keeper caught the trout, spawned them; hatched out the spawn, and turned in the fry when about three to six months old. This went on for some years.

The stream at first improved, but latterly all the artificial breeding seemed to make no effect. The owner took opinion after opinion; had the water analysed, got ova from a distance, and went to no end of trouble and expense. He told me about it, I could give him no help. He then begged me to come and see the place; I did so, but got no nearer a solution of the difficulty. I walked up the stream and down the stream; there were trout, but nothing to what there ought to have been. I saw his hatchery and he showed me his book, and I told him plainly that his men must sell the fry. He said he was quite sure I was wrong; I said I felt certain that the quantity of fry the book showed never went into the stream; we argued the question till late at night, but I was obstinate. The next day we went to the place again, and on the brook just below the outlet from the hatchery I got a clue. We went over everything again, and I still said I was certain that there was something destroying the fry. I proposed walking down to a farm that was below; we went, and I had some conversation with the farmer's wife. She said she did a good deal with her poultry, especially her ducks; that they did so well, and required hardly any fattening. My friend said this was so; he always got his ducks from her ; they were the best for miles round. I could not keep my countenance, and my friend thought I did not believe him. I replied that I now guessed what was the matter with the stream. Both he and the farmer's wife, however, declared that these ducks never ate fish. I said, of course not, and was told that was clear as they never tasted in the least fishy. I said nothing, but my friend was angry, saying I first suspected his servants, and then insulted the wife of his best tenant. I held my peace, but as we went up to the hatchery, I asked if there were any eels in the brook. My friend rose to this, and said I was now talking sense ; it might be eels. I said if he did not mind I should like to set two night lines to see if there were any. He was quite excited at the idea, and on the fords between the hatchery and the farm, I set the night lines baited with some of the largest fry in the hatchery. He wanted to make me put the night lines in the deep water, as he said eels were always there. I however said I would try the deep water another time. At dusk we set the lines. Early in the morning we went down to see the result, and, as my friend had said, I got no eels on the fords, but I did get two of those ducks that never took fish. I hastened to apologise for unjustly suspecting the servants.

The observations on the increase or decrease of fish require to be carried out for some time before any real idea as to results can be obtained. Meanwhile there must be no cessation in the other modes employed—systematic netting, taking out a certain number of fish yearly, and replacing them by a smaller or larger number, according to circumstances, both naturally or artificially. I am assuming that no exceptional circumstances occur, no pollution killing off half the fish, no disease, no very dry seasons; but that everything goes on smoothly. You can then be almost certain as to the result. Your work is or is not worth carrying on. You can tell what the river will produce. You know what you have put in and what you have taken out. Do you get either in the fish you sell or in the fish you catch sufficient value for their cost? This is a question each person must ask and answer for himself. All that can be said is, that fishery management is not a business at which fortunes are made; that the year invariably ends with an adverse balance.

The great principles are, ascertain what your stock of fish is, and what your stock of food is, kill off every year all those fish which do not contribute to maintaining the stock, or which prejudicially affect the maintenance of the stock. The working out of these principles requires infinite care and knowledge, which can only be learnt on the river. For instance, you desire to get rid of your coarse fish. How shall you do it? If you are to net, are you to net the whole of your fishery, or only some part? Do you wish to make a distinction as to kind of fish? Do you want to have only the fish bred in your water, or those bred in your neighbour's as well? If you really want to deal with your neighbour's fish, net every day in the season and out of it, the lower stretches of your water; when coarse fish are disturbed, they always work down stream, not up stream. If you cannot put a wire or a grating to keep them out, you can produce the same result to a great degree by persistent netting. It does not matter if you catch fish or not, as long as you are always disturbing the water. At one place I know, in the middle of about two miles of fishing there are two salmon drafts; during the annual close time these drafts are the great resort of the chub; during the fishing season there are practically no chub there; the netting keeps them away, or, as the local fishermen say, chub cannot stand the smell of hemp. You can thus cut off your coarse fish from getting new recruits, and are in a position to manage them as you please. How that will be done depends on your peculiar taste. Another point that has to be determined is, will you have a hatchery of your own, or buy what you want? Buying is the cheapest and, in some ways, the best if you know how to buy; but as gentlemen farmers always fail in the buying and selling, so do fishery owners. There is much to be learnt in buying ova, fry and yearlings, and the dealers quite rightly utilise the advantage of experience. One of the many stories told of the late Bishop Wilberforce was that once he sold a horse he had bred to a young gentleman who thought that because a horse had been bred by a bishop it must be a good one. The horse, soon after it was bought, developed a spavin. The purchaser was furious with the bishop, and when next he met him reproached him for selling him an unsound horse, adding, "I believe the Yorkshire nature is so strong in your lordship that you would sell an unsound horse to your own father." In his most saintly tone the bishop replied, or is said to have replied, "I only wish I could." Most of the professional dealers in fish act upon the episcopal desire. If you breed your own fish you must make up your mind not only to lose ova, fry, and even yearlings, but also much money and more temper. I know nothing which exhibits the ingrained stupidity of the ordinary keeper more than fish breeding. I know nothing where a slight mistake produces more aggravating results. But there is a fascination about fish breeding that is worth all the trouble and all the outlay both of money and of temper.

So far the fishery has been considered without reference to the migratory *Salmonidæ.* They are a disturbing element that not only upset all calculations, but, what is worse, the law that is supposed to preserve them places very important restrictions on what a fishery owner may or may not do, and things that would be very necessary and very useful to be done in a fishery cannot be legally done if a casual salmon comes up to spawn.

Probably the best way of stating what should be done in managing a fishery will be to point out the work that is necessary in each month. In an Appendix[1] will be found the directions the Severn

[1] Appendix I.

Fishery Board give to their water bailiffs as to what they have to look out for and what they ought to do in each month, and what, so far as a Corporation can have the gift of prophecy, may be expected to happen.

A fishery owner should, if possible, take, or, if he cannot do so himself, have accurately taken, certain observations on the weather, and on the arrival and departure of fish. He should have recorded—

1. The rainfall.

2. The height of the river, and further note what this means; what shoals are bare, and what are covered; and how deeply they are covered at the different heights of the water. For instance, a fall of an inch will leave such a shoal dry, so that all the ova or fry on it will perish. A fall of two inches will leave such a stream without water, so that a watcher should go up it to protect it from the birds, and from the holes being laded out. It is a great thing to be able to tell by looking at the water at one spot in your fishery what is the state of the whole fishery as regards water; and this information reading the gauge should at once give you. The maximum and minimum temperature of the air and of the river during the twenty-four

hours should be taken daily; this is the only reliable guide as to when the ova will hatch out, and by it one can usually learn fairly accurately whether it will be earlier or later than the normal time.

A reading of the barometer is also useful.

These observations should be made and recorded daily; and their average over a number of years forms a most important indication as to the suitableness or otherwise of parts of the river or of the tributaries for cultivation.

As to the migratory fish, it is also necessary to know something of the tides. Salmon run best on spring tides when these are reaching their highest, and do not run so well when the springs are going off or during the neap tides. If, therefore, a fresh and a high spring tide concur, a run of salmon is most probable; and it is often a matter of importance to know when salmon may be expected to arrive if ova are wanted for breeding.

In *January* the work to be done is, as to salmon, to look after the breeding fish when spawning, to get such ova as may be wanted for breeding, to get out all dead, and I should say, all dying or diseased salmon, and to notice if there are any kelts or pike in the ditches or backwaters.

If the rivers run low such trout as can be seen should be noticed, to discover whether they have all spawned. The condition of the coarse fish should be observed, if in shoals in the pools; if it is desired to net them out, a fine day is a good opportunity for doing it.

February.—Most salmon have done spawning; if they have not, it would be better to spawn artificially such as remain rather than to suffer them to rout up the beds. All dead fish should be got out and buried, all diseased fish got rid of. The salmon nets should be carefully examined to see what number of kelts are caught, what is their condition, and whether any unspawned fish remain. The backwaters and ditches should be carefully looked over for pike and kelts, and every opportunity should be taken of killing down the pike. The condition of the trout should be noticed as far as possible. If coarse fish are to be netted out, the time is favourable for it.

March.—The salmon nets should be still watched to see the state of the kelts, and every effort should be made to stamp out any appearance of disease. Everything should be done to help on the passage of descending kelts. A close watch should be kept on the young salmon, as they will be preparing to descend to the sea, and the silvery appearance of the scale will be coming on. Trout will begin to get into condition. Pike will be spawning, and should be killed down. Perch and ruff also may be spawning. Determined efforts should be made to keep down the coarse fish, which will now be found on warm days in the pools in great shoals, and can easily be netted out. The first batch of salmon ova, and most of the trout ova, should hatch out this month, and the tributaries and shoals should be carefully looked after. A fresh should take both smolts and kelts down, and a close look-out should be kept that nothing is placed to obstruct them.

April.—The kelts should have cleared out by this, but if not, a watch should be kept to get rid of diseased ones. Kelts and smolts will be going to the sea on any fresh, and every effort should be made to facilitate their progress. Trout should be carefully watched, they ought to be in condition, and if not, it shows that the food supply is not what it should be. Trout ova and salmon ova will be hatching out, and the shoals should be carefully watched and kept free from disturbance. Grayling are spawning this month. Some idea can be got as to the quality and amount of food by watching the backwaters and shoals, as caddis larvæ and the water snails and other aquatic forms can be well seen now. The supply of fly should also be noticed, and if it is more or less than in previous years; coarse fish spawning is going on, and if it is desired to kill them down, it can now be done with effect.

May.—All kelts and smolts should be out of the river by this time. The migratory trout are beginning to run up. The trout should be in the height of condition, and if not, it is clear there is something wrong, most likely as to food. Coarse fish will in most cases be spawning by the end of the month. Probably this month is the best time at which to get an idea of the stock of trout, and close observation should be made as to this, also as to the food and flies; particular note should be taken as to the surface food, whether or not there is a fair supply. If, after a series of years it appears that there is not a good supply in May, it is but little use preserving a river for angling. The question of the increase or decrease of the fly has also to be noticed; it will be best seen this month. The trout fry should now be visible and also the early hatched salmon, and the ova should be hatching out.

June.—The fresh-water fish will mostly have finished spawning, but chub often go on till the end of the month. The elvers will begin to run up, and some notion can be formed as to the stock of eels. The young salmon and trout should be carefully looked for, so that some idea may be gained how the spawning season has passed off. The first fry of the coarse fish will have hatched out, and may be seen in quiet corners and backwaters, and some estimate can be got from it of the quantity spawned. Food should be carefully observed, and if the fish feed much below the surface.

July.—Advantage should be taken of the low condition of the river to clean out the pools and do any work that may be required to preserve the channel of the river or to protect the spawning beds. Observation can be made as to the number of young fish, and an idea as to the result of the spawning season acquired. If the river runs low, the large trout that are past catching can often be seen lying alone at the same place day after day. They should be got out if possible, as they are doing no good. If the river gets very low and the pools are very full of fish, especially fish that have been turned in, it may be well to throw in some food. The danger is that it makes fish slow risers.

August.—The trout are much the same as in July, except that, if there are any freshets, migratory trout begin to run up to breed and also some salmon. If any clean salmon reach the upper water it is in this month. Pools should be very carefully observed, and a look-out kept for dead fish, as, if there is any pollution of consequence, it is more likely to make itself felt now than at any other time. The eels begin to migrate seaward; and a close watch on the nets should be kept to see if young salmon are migrating, and what other fish are caught. Grayling are beginning to get into condition, and should be noticed carefully, as they will show what the stock of food is. Also the coarse fish should be looked carefully after, to see if these are in larger proportion than can be fairly attributed to the last year's spawning, that is between three and four inches in length.

September.—The net fishing for salmon is now over, and some may run up to the upper waters. If there is any freshet, the spawning beds should be carefully watched to see if the migratory trout are beginning to spawn. The state of trout, too, should be noticed, to discover whether they are far advanced towards spawning. A last effort should be made to get rid of the large solitary trout. The first run of spawning salmon may, if there is a good fresh in the river, appear at the end of the month.

October.—The chief work to do is to watch the spawning beds. The migratory trout will spawn, and the early brook trout, and, it is possible, some of the early salmon may. The salmon will run up in considerable numbers, and all arrangements for watching the river during the spawning season will have to be made and put in force. If ova are to be taken for breeding, it may be well to try to get some of the early trout, and also to see what is the condition of the fish.

November.—This is, or ought to be, the great salmon spawning month, and the beds should be all most carefully counted, watched, and noted; probably all attention will have to be given to watching the *Salmonidæ* and taking ova during the month. There is nothing to be done of so great importance.

December.—Salmon and trout spawning continues, and the trout spawning should end. Most of the work, as in the last month, consists in protecting the fish, and in taking ova for breeding. A look-out should be kept for any dead fish, in order to see whether any deaths arise from other than natural causes. A close look-out should be kept for diseased fish. If the water keeps low, an attempt should be made to check the list already made of spawning beds, and get it as accurate as possible, so as to enable an idea of the spawning season to be formed.

What has been stated must not be looked upon as in any way a statement of the whole duty of fish management; all that it purports to do is to indicate the nature of the work that each month brings. There is plenty to do all the year round, and in each year the time for doing it varies with the condition of the weather, the stream, and a host of local matters. The great thing to remember is to observe everything; to consider nothing too small or too unimportant to note; never to be above learning anything from anybody, and not to believe that you know all about everything. If you carry on your fishery in this way, you will get much amusement, plenty of employment, a fair amount of sport, and healthy exercise;

you will also very likely be able to add some very important information to the knowledge of how fisheries should be managed, and what is the right thing to do. If this will content you, try fishery managing, and you will not be disappointed; but if you want either to make money or to know all about it, to be able to pose as a past master of the art, you had better turn to some other employment.

After saying this, I feel more than ever my presumption in writing this book, but, as I have said, it is only because no one has so far even ventured to outline a system of fishery management that I have been driven to do so. It is in the hope that I may induce others to enable me to learn more that I have ventured to say what I have said. On one point I am clear—an effort ought to be made to maintain the British trout. It is this belief that has induced me to say what I have against the coarse fish; not that they are not very well in their place, but their place is anywhere else than in a trout stream. A late eminent judge, who combined a great love of fishing with a great love of port, on hearing it said that the port they were drinking was bad, denied most emphatically that there could be any such thing as bad port.

All port, so long as it was port, was good; there were degrees in goodness, but there was no such thing as bad port, only the imitations were bad. So as to fishing: all fishing is good; there is no bad fishing, but there are various degrees of goodness. That trout fishing is many degrees better than coarse fish fishing will probably be the opinion of most of those who can speak practically of both.

APPENDIX (I)

THE following are the instructions the Severn Fishery Board issues to its water-bailiffs as a rough guide to them for each month.

JANUARY

NOTES AS TO FISH

Usually two runs of salmon this month; one at the middle and one at the end. The salmon that run up are mostly shoals of female gillings.[1] Single clean fish work up all through the month, and are generally large fish.

PROBABLE MOVEMENTS OF FISH

A run of spawning fish about the 14th.[2] Another run about the 30th. A run of lamperns about the 30th.

LOOK OUT FOR AND NOTE DATES OF—

I. *As to salmon and migratory trout*:—Kelts returning seaward.—Clean salmon ascending, and if singly or in shoals.—Spawning salmon ascending, if singly or in shoals, and sex of fish.—Dates of salmon spawning.—Particulars of any salmon found dead.—Particulars of any diseased salmon.

II. *As to other migratory fish*:—Date of runs, if large or small; size of lamperns and condition as to spawning.

III. *As to freshwater fish*: Condition of trout; latest date of spawning.—If any eels still descending river; if eels are spawning.—Condition of pike.

IV. *As to sea fish*:—If congers are spawning.—Date of runs of sprats, and if large or small.

METEOROLOGICAL NOTES

Average rainfall, 2·74 inches.
" pressure, 29·91 inches.
" temperature of air, 40°.

Average temperature of river,3
" " estuary, 34
" height of river at Diglis,[3] 17ft.

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[1] On the Severn a "botcher" is a grilse. A "gilling" is a grilse that has returned to the sea and is ascending a second time. A salmon is a gilling that has returned to the sea and is ascending a third time.

[2] These dates vary each year and are based on the tides.

[3] Diglis is the Weir at Worcester.

FEBRUARY

NOTES AS TO FISH

Usually no great run of salmon this month. A run of late spawners sometimes occurs toward the very end. A few spawning fish work up during the whole month and congregate below the weirs. During the first fortnight there is usually a good take of clean salmon in the middle waters, being the fish that have run up singly during January, and stayed below the weirs and in the drafts. After the first week the take of fish falls off greatly. If mild and warm, elvers begin to run at the end of the month.

PROBABLE MOVEMENTS OF FISH

If mild weather a few fish, chiefly salmon and gillings, run up about the 15th, and a small run of spawning fish about the 28th. A run of lamperns towards the end of the month.

LOOK OUT FOR AND NOTE DATES OF—

I. *As to salmon and migratory trout*:—Kelts returning seawards, all possible to be marked.—Clean fish ascending, if singly, or in shoals. Number caught, size, sex, weight.—Dimensions of salmon, gillings and botchers, and weight of roe or milt.—Spawning salmon, if ascending, and if so, singly or in shoals, sex, size; and if salmon, gillings, or botchers.—Date of spawning.—Particulars of any diseased salmon, and of any salmon found dead.

II. *As to other migratory fish*:—Dates of run of lamperns, if large or small, size of fish, conditions as to spawning.—Date of elvers running, if large or small number, and condition of elvers.

III. *As to freshwater fish*:—Condition of trout, latest date of spawning, if fish are in condition, &c.—If pike are beginning to spawn.—Condition of any other freshwater fish.

IV. *Sea fish*:—If conger, cod, plaice, flounder, sole, herrings, or sprats are spawning.—What fish, if any, are spawning.—Condition of shrimps.—If sprats have left off running, date of last run.

METEOROLOGICAL NOTES

Average rainfall, 2·27 inches.
" pressure, 29·93 inches.
" temperature of air, 41°.

Average temperature of river, 37°.
" " estuary, 37°.
" height of river at Diglis, 19ft. 3in.

MARCH

NOTES AS TO FISH

If weather keeps mild, single salmon, mostly large females, run up the river at the beginning of the month. A few very late spawners may be seen almost up to the end of the month. If after the 25th, the wind is in the south or south-west and the weather mild, a good run of gillings, mostly females, may be looked for, and if there is a fresh they will ascend into the upper waters. Kelts will be going down every fresh in the month. If any disease is about it will most likely show itself this month. The first lot of smolts should descend this month, and the first batch of eggs of the early spawned fish should be hatched on or about the 28th. Elvers will run if weather mild.

PROBABLE MOVEMENTS OF FISH

A run, the last, of spawning fish if there is water. A run of salmon about 14th, and possibly a few straggling spawners. A run of spring gillings all the month. Descent of kelts and smolts in any rise of water.

LOOK OUT FOR AND NOTE DATES OF—

I. *As to salmon and migratory trout*:—Kelts returning seawards, sex, dimensions, and number of any caught.

Diseased fish	Number of fish, with sex, weight, and dimensions, and whether salmon, gillings or botchers, and state of roe or milt.
New fish ascending ...	
Spawning fish ascending	
Fish spawning	

II. *As to other migratory fish* :—Date of lamperns running, and condition as to spawning.—Date of elvers running. —Date of eels ascending.

III. *As to freshwater fish* :—Condition of trout; if recovered from spawning, and latest date of spawning.—If pike, perch, ruff, or roach are spawning.

IV. *As to sea fish* :—If cod, whiting, plaice, flounders, soles, herrings, sprats, or sturgeon are spawning; or what fish are spawning.—Condition of shrimps.

METEOROLOGICAL NOTES

Average rainfall, 2·73 inches.
,, pressure, 29·89 inches.
,, temperature of air, 43°.

Average temperature of river, 39°.
,, ,, estuary, 39°.
,, height of river at Diglis, 15ft.

APRIL

NOTES AS TO FISH

It is unlikely there will be any considerable run of salmon until about the 13th, when there will probably be a run of small gillings from 7 to 10 lbs. During all the month a few large male fish from 30 lbs. upwards will be found in the estuary and lower fresh-water portion of the river. Elvers will run on the springs of the 15th and 27th. Twait should begin to run in the last week. Smolts and kelts will descend on every fresh.

PROBABLE MOVEMENTS OF FISH

Large run of gillings from 7 to 10 lbs. about the 20th, and probably a few twait and elvers same time.

LOOK OUT FOR AND NOTE DATES OF—

I. *As to salmon and migratory trout*:—Kelts returning seaward, all possible to be marked.—Smolts descending.—Clean fish ascending.—Spawning fish ascending. Any fish still spawning.—Number of clean fish taken, with the weight and dimensions—whether salmon, gillings, or botchers, and weight of roe or milt.—Diseased fish.

II. *As to other migratory fish*:—Lamperns—if still ascending or if descending; condition, size, and sex.—Lampries—if ascending and date when spawning; condition, size, and sex.—Elvers—if ascending; date, size, and condition.—Eels—if moving; date, size, and condition.—Twait—if ascending; date, sex, size, and condition.—Shad—if ascending; date, sex, size, and condition.—If any fry of salmon or trout are to be seen on the shallows.

III. *As to freshwater fish*:—If ruff, pike, perch, greyling, gudgeon, or rudd spawn this month, and what freshwater fish do spawn.

IV. *As to sea fish*:—If cod, haddock, whiting, plaice, dab, flounder, and sturgeon spawn this month, or what fish do spawn this month.—Condition of shrimps.

METEOROLOGICAL NOTES

Average rainfall, 2·02 inches.
" pressure, 29·93 inches.
" temperature of air, 48°.

Average temperature of river, 45°.
" " estuary, 48°.
" height of river at Diglis, 11ft. 11in.

MAY

NOTES AS TO FISH

No very large run of salmon during the month. Large male fish are often taken. Twait, shad, and lampries usually run this month. The spring migration of smolts and the seaward migration of kelts finishes. Disease generally disappears. The upward migration of elvers in the estuary usually terminates.

Probable Movements of Fish

A run of salmon about the 13th and 27th. A run of twait about the same time, and if they reach Worcester it should be about this time.

Look out for and note Dates of—

I. *As to salmon and migratory trout* :—Kelts returning seawards to be marked whenever possible.—Smolts descending seawards.—Diseased fish.—New fish ascending, sex, weight, dimensions, condition, and if salmon, gillings, or botchers, and state of roe or milt.—Condition of salmon caught in putchers, if kelts or clean fish, and if any other fish than salmon.—Salmon in upper waters, if kelts or clean fish.—If any migratory trout are caught, and if so when and where.—Fry on the shallows.—The majority of the salmon and trout fry spawned before Christmas should now be visible.

II. *As to other migratory fish* :—Twait ascending, number, size, and condition, and date of spawning.—Shad ascending, number, size, and condition, and date of spawning.—Elvers ascending, number, size, and condition.—Lampries ascending or descending, number, size, and condition, and date of spawning.

III. *As to freshwater fish* :—If perch, ruff, greyling, carp, gudgeon, chub, rudd, minnow, bream, and roach are spawning, or what fish are spawning.—Date of any fish noticed spawning to be given.

IV. *Sea fish* :—If cod, haddock, whiting, plaice, dab, flounders, soles, herring, and sturgeon are spawning; or if any other fish are spawning.—Condition and number of shrimps.

METEOROLOGICAL NOTES

Average rainfall, 2·37 inches.
,, pressure, 29·98 inches.
,, temperature of air, 60°.

Average temperature of river, 57°.
,, ,, estuary, 50°.
,, height of river at Diglis, 11ft. 4in.

JUNE

NOTES AS TO FISH

The first summer run of botchers usually takes place this month. If there is a fresh, a run of salmon to the upper waters takes place. Migratory trout begin to run up the river. A few late smolts may be found descending: twait and shad are usually out of the river before the end of the month; the elver migration is mostly over at the end of the month throughout the river.

PROBABLE MOVEMENTS OF FISH

A run of botchers about the second week of the month; the first run should be good-sized fish from 5 to 7 lbs. males. Possibly run of twait and lampries about the 11th and 25th.

LOOK OUT FOR AND NOTE DATES OF—

I. *As to salmon and migratory trout*:—Clean fish ascending; if singly or in shoals; whether salmon, gillings, or botchers; size, weight, sex, dimensions; number of salmon caught, and weight of roe or milt.—If any kelts are remaining in the river or descending.—If any smolts are descending.—Any diseased fish.—Any migratory trout, if so, give the same particulars as for salmon as nearly as possible.

II. *As to other migratory fish*:—If any lampries are ascending or descending, dates of each.—If any elvers ascending in any part of the district, size of elvers, and if in large shoals.—If any twait or shad ascending or descending, and date of each, number of fish, and if any noticed spawning, date when.—If lampries are spawning, and date.

III. *As to freshwater fish*:—If all freshwater fish have finished spawning; if not what are still spawning.—Condition of freshwater fish, if spawning or about to spawn, and if fit to be taken.

IV. *Sea fish*:—What sea fish are spawning.—What young of sea fish are in the estuary.—Condition of shrimps.

METEOROLOGICAL NOTES

Average rainfall, 2·37 inches.
,, pressure, 29·98 inches.
,, temperature of air, 60°.

Average temperature of river, 57°.
,, ,, estuary, 50°.
,, height of river at Diglis, 11ft. 4in.

JULY

NOTES AS TO FISH

Usually a large run of botchers towards the end of month. A few large male fish may be taken, but the bulk of the fish are small botchers, mostly males. If a dry month a great catch of salmon should be made in the estuary and lower waters. Female salmon get discoloured, and the roe begins to develop. Eels begin to migrate seawards. Migratory trout are getting out of condition, and begin to run up preparatory to spawning.

PROBABLE MOVEMENTS OF FISH

A large run of salmon, mostly botchers, may be looked for about the 8th and 25th; the last will be the great run of botchers of the year.

LOOK OUT FOR AND NOTE DATES OF—

I. *As to salmon and migratory trout*:—Number of salmon ascending, if singly or in shoals, and if salmon, gillings, or botchers, and condition of the fish.—Number, weight, dimensions and sex of all salmon caught; and if salmon, gillings, or botchers, and weight of roe or milt.—And also same notes as to migratory trout.—If any diseased fish.

II. *As to other migratory fish*:—Eels migrating seawards, number, size, and date.

III. *As to freshwater fish*:—If tench or bleak are spawning, or if any other fish are spawning.—Condition of freshwater fish.

IV. *Sea fish*:—What fish are now found in the estuary.—What young fish are to be found in the estuary.—Condition and number of shrimps.

METEOROLOGICAL NOTES

Average rainfall 2·79 inches.
,, pressure, 29·95 inches.
,, temperature of air, 62°.

Average temperature of river, 64°.
,, ,, estuary, 60°.
,, height of river at Diglis, 11ft. 3in.

AUGUST

NOTES AS TO FISH

There is usually a run of gillings as well as botchers during this month, frequently in large numbers, but the fish get discoloured and out of season, and the roe becomes largely developed. Among botchers as a rule there are this month more females than males.

PROBABLE MOVEMENTS OF FISH

There will probably be a large run of fish about the 11th. On the 24th, the last great run of the season should take place, and if a fresh there should be a good run through the district, probably the largest in the year.

LOOK OUT FOR AND NOTE DATES OF—

I. *As to salmon and migratory trout*:—Clean fish ascending, number, whether in shoals or singly, number caught, condition of fish, how far advanced towards spawning, colour, sex, and dimensions. Whether salmon, gillings, or botchers, and state of roe or milt.—If any salmon are found dead, weigh their roe and milt, and count the number of ova to an ounce.—Note the young salmon on the fords, and the different sizes of those found in the river, and if any are taken in eel nets or traps.—Any migratory trout ascending, if so, condition and number, and if spawning or about to spawn.

II. *As to other migratory fish* :—If any lamperns ascending.—What fish are caught in the eel nets and traps.—What eels are migrating seawards, quantity, and size.

III. *As to freshwater fish* :—As to whether trout move near to the weirs.—As to white fish collecting in shoals.—Condition of greyling, and number and size of those taken.

IV. *Sea fish* :—Number of whiting and codlings in the estuary, and date of their departure.—Condition and number of shrimps.—What other fish are caught in the estuary.

METEOROLOGICAL NOTES

Average rainfall, 3·03 inches.
,, pressure, 29·94 inches.
,, temperature of air, 62°.

Average temperature of river, 61°.
,, ,, estuary, 60°.
,, height of river at Diglis, 11ft. 3in

SEPTEMBER

NOTES AS TO FISH

The run of botchers falls off, and a run of fish from 9 to 16 lbs., "Michaelmas gillings," takes their place. These fish are mainly females. Lamperns ascend, eels descend, and the autumn migration of smolts begins. Migratory trout begin to spawn.

PROBABLE MOVEMENTS OF FISH

A run of fish (female gillings) during the second week; and if a fresh, a large run of fish, about 23rd, the first great run of spawning fish. A run of lamperns may also be looked for about the same time.

LOOK OUT FOR AND NOTE DATES OF—

I. *As to salmon and migratory trout*:—Clean fish ascending, number, size, and if singly or in shoals.—Spawning fish ascending, number, size, and if singly or in shoals, and if salmon, gillings, or botchers.—Condition of fish in the estuary, colour and appearance; sex, weight, and dimensions of any found dead, whether salmon, gillings, or botchers, and weight of roe or milt.—If any fish seen spawning, and if migratory trout or salmon, date, place, size and number of fish.—If any smolts with silvery scales are in the river, or any caught with eel nets or traps.

II. *As to other migratory fish*:—Dates and run of lamperns, number and size of fish.—Number and size of eels caught with traps or nets, and date of run.

III. *As to freshwater fish*:—Condition of freshwater trout, state of roe or milt, number of ova in each fish.—Condition of greyling, number caught.—If white fish are collecting in shoals.

IV. *As to sea fish*:—What fish are found in the estuary.—If codling and whiting have left.—Condition and number of shrimps, and of any migratory fish found in estuary.

METEOROLOGICAL NOTES

Average rainfall, 3·34 inches.
" pressure, 29·92 inches.
" temperature of air, 57°.

Average temperature of river, 58°.
" " estuary, 60°.
" height of river at Diglis, 11ft. 4in.

OCTOBER

NOTES AS TO FISH

The run of Michaelmas gillings will continue, and a few large male fish will be seen about. The first spawning fish should be on the beds this month. If no fresh the fish lie about the estuary and the river up to Tewkesbury, gradually working up singly. Run of lamperns up river continues. The great autumn migration of eels takes place this month.

PROBABLE MOVEMENTS OF FISH.

A run of fish during the first week, but if large or small depends on whether there is a fresh in the river or not. The fish will probably be Michaelmas gillings. If a fresh the great run of eels will be about the 20th. From about the 28th onward salmon will be on the spawning beds.

LOOK OUT FOR AND NOTE DATES OF—

I. *As to salmon and migratory trout*:—Dates and condition of salmon appearing at weirs; if salmon, gillings, or botchers.—Condition of salmon seen in the estuary; sex, weight, and dimensions of any found dead or stranded; and if dead ones, size and weight of roe or milt.—Dates of spawning salmon, and size of fish, salmon, gillings, or botchers.—Condition of any clean fish seen, and if salmon, gillings, or botchers.—Smolts migrating seaward.—Date of any kelts seen, and if salmon or migratory trout.

II. *As to other migratory fish*:—Eels descending; quantity, size, and condition, and what fish besides eels are taken in eel nets or traps.—Lamperns caught, size, and condition, and if in large or small numbers.

III. *As to freshwater fish*:—Trout spawning; date and condition of fish.—Condition of trout.—Greyling: number caught, size and condition.

IV. *Sea fish*:—What fish are found in the estuary.—Whether any fish are spawning in the estuary; whiting, turbot, dab, flounder, and sole are said to spawn.—Condition and number of shrimps.—If sprats have come, if so on what date, and in what number and condition.

METEOROLOGICAL NOTES

Average rainfall, 3·25 inches.
,, pressure, 29·88 inches.
, temperature of air, 51°.

Average temperature of river, 51·3°.
,, ,, estuary, 54°.
,, height of river at Diglis, 14ft. 7in.

NOVEMBER

NOTES AS TO FISH

At the beginning of the month there are generally a quantity of fish in the estuary, but after these have worked up the great number of fish are no longer found in the lower water. Salmon continue to spawn throughout the month; towards the end kelts will begin to return seawards. The eel migration is almost over. Lamperns continue to run up.

PROBABLE MOVEMENTS OF FISH

A run of fish in the estuary about the 17th.

LOOK OUT FOR AND NOTE DATES OF—

I. *As to salmon and migratory trout*:—Date and condition of salmon at weirs, and spawning; whether salmon, gillings, or botchers—Sex, size, dimensions, weight of any fish found dead, and whether salmon, gillings, or botchers. Particulars of all dead fish.—Date and place of appearance of diseased fish.—Date and place of salmon seen spawning, whether numerous or not.—Date and place where any kelts seen, and condition of kelts.—Date of any clean fish seen, and if salmon, gillings, or botchers—Whether any smolts found in silvery condition or migrating seawards.

II. *As to other migratory fish*:—If any eels descending, and if so, size, condition, and quantity: date of last setting of traps and nets.—Run of lamperns, date; condition of lamperns, size; and if in large or small numbers.

III. *As to freshwater fish*:—Greyling, number caught, size and condition.—Number, size, and condition of all freshwater fish caught.—Condition of trout, date of spawning, number and size of trout seen spawning.

IV. *Sea fish*:—Kind of fish frequenting estuary.—Whether any spawning.—Condition of shrimps and number.—If sprats have arrived, and if so, when and in what quantities and size.

METEOROLOGICAL NOTES

Average rainfall, 2·54 inches.
„ pressure, 29·90 inches.
„ temperature of air, 43°.

Average temperature of river 43·7°.
„ „ estuary, 40°.
„ height of river at Diglis, 17ft. 5in.

DECEMBER.

NOTES AS TO FISH

Salmon continue to spawn all this month. The second great run of spawning fish usually occurs this month, a large proportion of the fish being males. A few clean fish generally migrate up the river and kelts return seaward. The trout spawning and the eel migration are generally over. Lamperns continue to ascend.

PROBABLE MOVEMENTS OF FISH

A run of fish may be expected during the first week, and another at the middle of the month. If any fresh, kelts will descend seaward.

LOOK OUT FOR AND NOTE DATES OF—

I. *As to salmon and migratory trout*:—Date, appearance, and condition of salmon, at weirs, and whether salmon, gillings, or botchers.—Condition of fish seen stranded or found dead in estuary, whether salmon, gillings, or botchers, size, weight, and dimensions.—Condition of roe or milt.—Appearance of any diseased fish.—Date and condition, sex, and number of fish spawning, whether salmon, gillings, or botchers.—Any kelts descending seawards.—If any smolts with silveryscales are migrating seawards.—Date of appearane of clean salmon, size, and whether salmon, gillngs, or botchers.

II. *As to other migratory fish* :—Last date of eels'descending seaward; and, if eel nets set, what fish were caught in any eel nets or traps.—Run of lamperns, size and condition of lamperns, and if in large or small numbers.

III. *As to freshwater fish* :—If trout have finished spawning, condition of trout, latest date of spawning.—Dates, quantity, and condition of any freshwater fish caught with rod and line.

IV. *As to sea fish* :—What fish are spawning in the estuary. —Sprats and congers are said to spawn.—Date of run of sprats, condition of fish, size, and if in large or small numbers.—Condition and number of shrimps. —What fish are found in the estuary.

METEOROLOGICAL NOTES

Average rainfall, 2·54 inches.
„ pressure, 29·90 inches.
„ temperature of air 43°.

Average temperature of river, 43·7°.
„ „ estuary, 40°.
„ height of river at Diglis, 17ft. 5in

APPENDIX (II)

THE following Memorandum was prepared for the Severn Fishery Board in 1897, to give the case for and against coarse fish :—

SALMON OR COARSE FISH.

We have reached a point in the history of our fisheries from which a new departure must be made. Thanks to two causes, (*a*) the making of laws for one purpose and then adapting them to another, (*b*) the change in the constitution of Fishery Boards brought about by the Local Government Act, 1888, we have already on some of our Boards, and soon shall on all the others, be brought face to face with the question—What is to be the future of the trout and salmon fisheries of England and Wales? Are they or are they not to be preserved, or are our rivers to be given up to the cultivation and development of coarse fish? The question is the most important that has ever arisen in connection with our inland fisheries, and it urgently presses for decision. In a few years, if nothing be done, it will have decided itself in favour of the coarse fish; and certainly, whatever the decision may be, it is too important a question to be allowed to go by default. The public seem to be wholly unaware that any such point has arisen for decision. The Board of Trade ignore it. The Inspectors' Reports contain no mention of it.[1] They talk about fishery legislation, about amending the existing laws, about codification. These may be all most desirable subjects to consider, but before they are dealt with this principle has to be determined—What direction is legislation to take?—is the preference to be given to *Salmonidæ* or to coarse fish? Until that is settled all legislation is useless, and codification will be positively mischievous. It will only tend to aggravate existing evils, or rather to bring about greater evils. Members who represent the coarse fish anglers contend that the Board does not do enough to protect and increase coarse fish. If it is urged that any such steps mean certainly the decrease of the trout, probably of salmon, the cry still is, "Never mind—protect the coarse fish, for it is said the poor man has to be considered, the coarse fish are his fish, the trout and salmon the rich man's"—and the Board are asked to make bye-laws to increase the coarse fish, even if it be found that that increase will tend to the decrease of the trout and salmon. The terms *Salmonidæ* and coarse fish are here used to distinguish the two great classes of fish, trout and salmon on the one hand (*Salmonidæ*), and all other fish on the other. For this purpose greyling, although *Salmonidæ* scientifically, would be looked upon as coarse fish. It is probable some such bye-laws will be made. What will be the action of the Board of Trade if they are? How will they decide? It is dangerous to prophesy, but it is certain that unless the public who are interested in fishing come forward and press on their views, the decision will ultimately be for the coarse fish. The one power that is potent with all Government Departments, far more so than all the reports of all the Inspectors, is votes in the House of Commons. The coarse fish anglers say that they include a very considerable portion of the electorate of Sheffield, Nottingham, Birmingham, Bristol, and other boroughs. It may be true they cannot themselves return members, but it is equally true that they may by abstention turn elections. That is their power. They know it and make no secret of it, nor of their intention to use it. Probably it is grossly exaggerated. All faddists allege they are much stronger than they are in reality; but if the time comes, as it may, when every seat is of vital importance to the existence of a Government, it will require a President of the Board of Trade who is a most keen salmon angler to decide in favour of *Salmonidæ* against votes, even if he would be allowed to do so by the Cabinet.

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[1] This is not quite accurate: since this Memorandum was published it has been mentioned in Mr. Fryer's last Report; but he declines to express an opinion, "as the whole circumstances have not yet been brought to his knowledge."—*Thirty-seventh Report*, p. 6.

Fortunately, for the present, such a contingency is not likely to arise, so therefore it is all-important to get the matter settled at once, and the principles on which the Board of Trade shall act as to the future laid down. It will be for those interested in the matter to say what course must be followed. But it must be carefully borne in mind that the *Salmonidæ* can only be saved by prompt action; delay or inaction mean the victory of the coarse fish.

A statement of the general principles of Fishery Management, including the steps to be taken to develop the fisheries, will show how entirely antagonistic are the interests of the *Salmonidæ* and the coarse fish which Parliament is now asked to assume, and has assumed, to be identical, and has tried to regulate under one set of statutes "the Salmon and Freshwater Fisheries Acts."

Before considering the principles of management it will be well to say a word on the necessity for it. Most persons think that if illegal fishing is stopped, only a moderate amount of fly fishing allowed, all netting prohibited, and a certain number of trout turned into a stream annually, all has been done that can possibly be done for the river. There are numbers of persons, both owners and occupiers, who hold this idea as a matter of faith, and who complain bitterly that after all they have spent on the river it does not improve, who are willing to do whatever they are advised should be done if they can only be sure that the river will really be benefited and the fishing bettered. Owners and occupiers are quite ready to spend money if they can be sure of real results from their expenditure. So far they have usually had no results at all, and they get tired of a large outlay producing nothing—of merely chucking their money into the river.

A very little consideration will at once show why the present plan must be a failure. It proceeded upon an idea, which in nine cases out of ten is erroneous, that the river is insufficiently stocked with fish, and the great thing is to increase the stock. It is quite true that, as regards *Salmonidæ*, this is usually the case. Probably no English or Welsh river is fully stocked with salmon. A few—a very few—are fully or probably may be over stocked with trout, such as some of the Duke of Bedford's Hertfordshire water; in most cases the stock of trout is under what it should be. But most of our rivers in which there are trout and coarse fish have too many of the latter. In some cases it is one kind, in others, another; but the stock of coarse fish, taken as a whole, is above what is required for the stream. It often happens that the fish are small, too small for anything but to be weighed in at angling competitions. This number of small fish is the real evil in our rivers; this is caused by the stock of fish being more than the food supply of the river can properly provide for. The real remedy is either to lessen the stock of fish or to increase the stock of food. The present remedy aggravates the evil, by trying to increase the stock of fish while neglecting to increase the stock of food. Fewer fish are taken out by the means of capture being reduced, and in this way the stock is increased. To aggravate matters, more mouths to be fed are turned in, and the food supply being inadequate for the then existing requirements, is made still more inadequate by increased demands on it. If a farmer who was short of keep, instead of selling and decreasing his stock, bought more stock, every one would say he was ignorant of the first principles of his business; this is just what, on the advice usually given to them, is done by the owners and occupiers of fisheries. They do not get rid of any of their stock, however useless it may be, and not only take steps to prevent any decrease in the existing stock, but actually buy and turn in more, when their food supply is already too small for what they have. The first principle therefore in fishery management is to ascertain what is the food supply, and regulate the stock of fish in proportion to it. Do not try to make matters worse than they are by adding more mouths to consume a supply already insufficient for the demands on it.

In former days the stock of fish was less than the food supply could support. There was then, plenty for all to eat, and so the fish grew and throve; there were not so many fish in the river as now, but they were more sizeable fish, for the number was kept down, and there was therefore enough food to allow all to eat and grow. We have changed all that. There is now less fishing, so more fish, but the fishing has become worse because there is no longer plenty to eat; the stock of fish is in excess of the food supply, and the river is now full of small fish that cannot grow, as they have not enough food. Any improvement must begin by restoring the proper proportion between the stock of fish and the food supply. For this purpose some mode must be employed to arrive at an idea on each of these heads. The first principle of fish preservation and management is, therefore, to try to ascertain what is the stock of fish? The next, what is the food supply? Having ascertained these the next is to find out which is to be increased; if it is the food supply, and it usually is that which needs increasing, what are the steps to take to do it? This involves further inquiries, first, into the nature of the river, and whether there are any preventable causes existing that tend to decrease the stock of food or otherwise retard its development, such, for instance, as pollution. And next an inquiry into the water supply of the river, and the fluctuations to which it is subject. From these especially, if they are caused artificially, a great diminution may take place in the food supply.

So far there would be little difference in the management of a fishery, whether it was for *Salmonidæ* or for coarse fish.

The rule that the stock of fish must be proportioned to the food supply applies equally to all kinds of fish, as do also the principles that follow from it: that if the stock of fish is too large for the food supply, the remedy is either to decrease the stock or increase the supply. In most cases it is far easier, and probably far better, to decrease the stock of fish. Here, therefore, we are face to face with the question, how is it to be done? Is it to be done in favour of *Salmonidæ* or coarse fish? It will be therefore seen that, as the true question as to the development of our fisheries, or rather, the systematic management of our fisheries, depends on a proper adjustment of the food supply to the demands upon it, and if the demands are excessive they must be reduced, on what principle is the reduction to be made? We are, therefore, at once face to face with the question as to whether we are to preserve *Salmonidæ* or coarse fish? Coarse fish anglers have induced Fishery Boards to make all netting illegal. If any reduction in the number of coarse fish is to be made it can only be done by allowing netting in some way. What netting should be allowed and under what conditions are matters to be dealt with under the question of regulation of fisheries, but in some form or another netting is essential to keep down the number of coarse fish. If no netting is allowed, that is, if the coarse fish are allowed to go on increasing, then trout will gradually disappear, they will in effect be starved out. Is this to be allowed? It is a matter worthy of very careful consideration, having regard to all the facts of the case, whether it is not desirable, at all events in some rivers that are well adapted to coarse fish and not adapted to *Salmonidæ*, it would not be better to give up those rivers entirely to coarse fish, and do all that can be done to make them really first-rate coarse fish rivers. But if this policy is adopted it should be done designedly and avowedly, not as the indirect result of a system that was supposed, erroneously supposed, to protect *Salmonidæ*.

There is, however, another point for consideration. No really good coarse fish fishing can be obtained by the present mode of procedure. If a river is devoted to coarse fish, if it is to produce good fishing, it requires care and management, just as much as if devoted to *Salmonidæ*, and a necessary part of that management is proper netting. The present policy of the coarse fish anglers is based on ignorance, suicidal ignorance, of the habits of fish. By abolishing netting they have got up a stock of fish that is too great for the river to carry, that cannot grow as they are half starved, and which, if retained as at present, make the river go from bad to worse.

Probably, every one who has had any experience in the matter will agree that the total abolition of netting is not an unmixed blessing, but on the next step there will be great differences of opinion as to what fish should be retained in the water and what taken out. For the present, all that need be said is, a certain number of fish should be taken out of each river in each year, and to prevent this being done by making it illegal to use the only effective way of doing it is the height of folly. Fish when they reach a certain age and size cease to breed, and do nothing but eat. These fish will practically not take a bait. They are doing positive harm to the river by remaining in it, and should be cleared out as soon as possible. There may be very great differences of opinion what fish should be annually taken out of the water, both as to the kind of fish, as to the number, and as to size; but all reasonable people will agree that such as are useless should be taken out, and proper means should be employed to do this, but this can only be done by properly regulated netting.

So far this elementary principle has not been regularly recognised, and its proposal always raises a storm among the anglers, who at once say that the Board is acting in direct opposition to their interests in considering anything of the kind. But this is the fact we have to face. Is the present unsatisfactory state of things to go on, or shall an attempt on reasonable principles be made to improve the fisheries, of whatever kind they are? Here it is where the Board of Trade come in. If they would refuse to allow the total abolition of netting, and only sanction the restriction of netting, they would do far more for the fisheries than they have done by allowing the indiscriminate abolition of all netting.

A word should be said on another fond delusion, namely, that turning a number of fish into a river every year must of necessity improve it. Like netting, stocking properly carried out is most advantageous to a river; like netting, if improperly used, it is prejudicial, and, like the abolition of netting, it is also harmful. If the stock in a river, from any cause, is depleted too largely, stocking is of importance to bring it back to its proper level. But promiscuous stocking without any regard to whether the fish are wanted or not is the height of folly. It may do this possible good, it may add to the food supply by furnishing a meal for the large fish, but if it does not do that it only adds to the number of fish that are already underfed. Fish that are underfed neither grow nor breed as they should do. So that in a river with a deficient food supply not only is the fishing spoilt by the large number of small fish, but also by the fish that might be productive being less in size than they ought to be.

There is only one sound principle on which our inland fisheries can possibly be managed, and that is to treat them in the same way as a farmer treats a farm. A certain amount of keep, a certain amount of stock. There are great variations as to how much keep will be required for a given number of stock in different localities; but there is always, and there must always be, a proportion maintained between the two. It is just the same in our rivers; they will only carry a stock of fish proportioned to the food supply of each river. Having ascertained what that is and what are the possible limits of increase of the food supply, the stock of fish can be increased or diminished as the food supply is increased or decreased, but only within these limits. When they have been ascertained the further question comes, what fish shall be kept? And here, also, the example of the farmer applies. He keeps in theory the stock most suited to his farm; so the fish should be kept most suited to the river, with perhaps this qualification, that the fish selected should be the best kind of fish the river will produce. On this opinions will of course differ; but unless persons are wilfully perverse, this and the other principles that have been stated should have universal acceptance. The only way to manage a river is to do it on a rational system, not in a happy-go-lucky way that has no principle at all. These principles are: (1) That the supply of food is the factor that determines the question of the stock of fish. (2) That those who manage the river, or part of the river, should regulate the stock of fish by the amount of the food supply. (3) That it is no good wasting food on fish that are not doing, and are never likely to do, any good; and (4) That each river should keep the best fish it is able to produce, and maintain them as far as possible in the highest condition. If these principles were only acted upon by Fishery Boards, there would be far better fishing than there is at present.

There is another consideration that is altogether left out of sight: the breeding powers of *Salmonidæ* and coarse fish. No one who has paid any attention to the matter but is aware that fish for fish the number of eggs produced by a Salmonoid fish are far less than those produced by a coarse fish. It is not necessary here to give details; but let any one who doubts this statement take the spawn from a 4-ounce trout and a 4-ounce dace and count it. He will find the balance in favour of the dace most startling. Even allowing that a greater proportion of the eggs of *Salmonidæ* hatch out than the eggs of coarse fish, although there is no really satisfactory evidence that this is the case—even allowing this, the balance in favour of the coarse fish is enormous. This fact alone, that the reproductive powers of coarse fish are far greater than the reproductive powers of the *Salmonidæ*, points to the fact that if the two are to exist in the same water, it can only be by doing something to bring about an equality between them, that is, to net out a certain number of coarse fish every year. But it is usually assumed that coarse fish and *Salmonidæ* will live happily together, and it is a matter of wonder to Fishery Boards that they do not thrive together. We have not reached yet on land the Hebrew prophet's ideal of the wolf lying down with the lamb; when we do, perhaps in our rivers the *Salmonidæ* and coarse fish will thrive together, but it will not be until then.

Another consideration is also ignored: the changes made in our rivers by weirs, and dams, which are all in the favour of coarse fish and against *Salmonidæ*. Places that used to be good spawning ground for *Salmonidæ* are so no longer. Year by year the area of spawning ground becomes less, and the fish either spawn on unsuitable ground, and the spawn is lost, or the suitable ground is overcrowded, with a like result. All the changes of modern life are in favour of the coarse fish and against the *Salmonidæ*. If this is doubted, let any one go to the rivers in the West Midland districts, and they will find rivers that within living memory were good trout streams, now hold nothing but chub and dace. A weir is put across the mouth of a stream, or is raised or altered so that the water above is more dammed up than before; the trout spawning ground is cut off, the coarse fish increase, and at last, drive the trout entirely out of the river, not only by their greater reproductive powers, but by the fact that the *Salmonidæ* have every possible obstacle to their reproduction increased by artificial means.

There is also the further advantage that coarse fish have: they are stronger, or perhaps less susceptible to the polluting liquids that are so often poured into our streams than the *Salmonidæ*. The first fish to turn up on polluting matter coming into a stream are young salmon; the next trout; it takes a stronger dose to turn up the chub and dace. District Councils are fond of saying that fish will live in the effluent from their sewage works, but they never say what kind of fish will live, and it always turns out to be some kind of coarse fish, not *Salmonidæ*. The spawning beds of *Salmonidæ* are also far more liable to be injured from pollution than the spawning places of coarse fish, and it will be found that in a polluted stream the trout will disappear long before the coarse fish.

All these considerations point to the fact that if it is desired to preserve *Salmonidæ* in our rivers, it can only be by taking some means to prevent the increase of the coarse fish; that if left to themselves the coarse fish will supplant the *Salmonidæ*. It may be said that this is only the result of the rule of the survival of the fittest—that the coarse fish are suited to the circumstances of modern life and so they survive; that to try and fight against such a state of things is both impossible and absurd. But Fishery Boards were formed not for the preservation of coarse fish, but for the preservation of salmon—not for the angling working man, but for the increase of the public food; and if Fishery Boards were true to their duties they would take steps to carry out the purpose for which they were formed. It is only since 1878, when an ill-advised attempt was made to apply the Salmon Fishery Acts to coarse fish, that the difficulty has arisen. Before that date a Fishery Board would have killed down the coarse fish as a game preserver does stoats.

Even now the difficulty would not be so great if members of a Fishery Board did not desire to assist in the effort of getting rid of *Salmonidæ* by further aiding the increase of coarse fish—that is the policy they have urged and are urging, and which the Board of Trade have meekly accepted. But they can hardly be ignorant of the fact that in the only salmon river in England and Wales that has really been a success under the existing fishery laws, the Usk, every year the coarse fish are habitually netted out; that there this policy has been pursued for years with the result that there is really good salmon and trout fishing in the Usk—better than in any other river.

The only people on the Boards who know their own minds and pursue a definite policy are the coarse fish anglers; whether they are right or wrong is another question. I believe them to be wrong, and I believe that they are ruining the fisheries of the country, not only of the *Salmonidæ*, but also of the coarse fish by the line they are taking. But I also believe that this is not their intention, but that it is ignorance, suicidal ignorance, of first principles, that causes them to persist in their present policy. But whatever is the cause, the fact remains that unless something is done at once the days of the *Salmonidæ* in our rivers are numbered. If anything is to be done, that policy must be changed at once; things are daily getting worse, and there is no time on some of our rivers for collecting information or inquiry into the matter; what we want is action by the Boards. The first thing they have to deal with is to give a decided answer to the question—Are coarse fish or *Salmonidæ* to be preserved? Whether, being Boards formed for the protection of salmon, they can legally turn themselves into Boards for the protection of coarse fish and the consequent destruction of salmon may be doubtful. But this is not the consideration that is urgent. The vital question is for them to say what they will do.

J. W. WILLIS BUND.

October 20, 1897.

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